CONFRONTING THE MACHINE

An Enquiry into the Subversive Drives of Computer-Generated Art

Thesis
Presented to the Faculty of Arts and Social Sciences
of the University of Zurich
for the Degree of Doctor of Philosophy

by Boris Magrini

Accepted in the Spring Semester 2015
on the Recommendation of the Doctoral Committee:
Prof. Dr. Philip Ursprung
Prof. Dr. Verena Kuni

Zurich, 2016

Table of contents

Acknowledgments

First and foremost, I want to sincerely thank Prof. Dr. Philip Ursprung, of the Institute of the History and Theory of Architecture at the Swiss Federal Institute of Technology, Zurich, for accepting to supervise my research thesis and for countless and valuable observations and advice during this lengthy process. I have particularly appreciated his constructive critique, as well as his encouragement to develop my own perspective on the subject of enquiry while staying true to the sources. I would also like to sincerely thank Prof. Dr. Verena Kuni, Goethe University of Frankfurt, for her kind consent to evaluate the thesis as second referee. In particular, her precise remarks as a specialist of digital art have sharpened the revision of my thesis. I am also deeply indebted to Dr. Nina Zschocke, Scientific Coordinator of the Doctoral Program Pro*Doc Art&Science (SNF), who has helped to broaden my understanding of the subjects with many discussions and profound comments on the chapters. Furthermore, the arguments presented here have benefited from conversations and correspondence with many colleagues and friends, to whom I am deeply grateful, among them: Dr. Linda Dalrymple Henderson, Dr. Edward Shanken, Dr. Jillian Scott and Dr. Susanne Jaschko. Particular thanks must go to the artists, curators and researchers who granted me interviews and constructive remarks on my writings: most notably Harold Cohen, Vuk Ćosić, Simon Lamunière, Simon Penny, Ken Rinaldo and Christa Sommerer. Many thanks also to some of the members of the Schweizerische Gesellschaft für Mechatronische Kunst who provided me information essential to my understanding of the assembler program of the Senster: Markus Sing, Bernhard Wagner and particularly Veli Hämmerli for his considerable analysis. I could not have completed my research without the consultation of the Victoria and Albert Museum archive: Melanie Lenz, Curator of Digital Art, was of invaluable help for the consultation of the printed works of computer art in the collection. I am also very grateful for the numerous conversations with my colleagues of the Pro*Doc Art&Science: Dr. Sarah Schlachetzki, in particular, has been a helpful partner of many discussions and has given me valuable advice.

Sarah Culhane must be acknowledged for her enlightened and thorough revision of the manuscript. I have been generously supported by the Fondazione Alfred Loppacher e Hélène Mettler with a three-year grant, I am sincerely grateful to Avv. Fabio Abate for this support. Finally, my deepest gratitude goes to my parents, Luigi and Tamara Magrini for their love and support throughout the years it has taken to carry out my research.

Introduction

Between Good and Evil

The Singularity University, founded in 2008 by Peter Diamandis and Ray Kurzweil, exemplifies the optimistic stance regarding the usefulness of modern technologies for the improvement of our society. Its avowed mission is to "apply exponentially growing technologies, such as biotechnology, artificial intelligence and neuroscience, to address humanity's grand challenges".[1] Indeed, the name of the unaccredited university located in Silicon Valley explicitly points to the evolutionary transhuman theories supported by its founders. Singularity is in fact the term used by Kurzweil in his publications to describe the predicted moment, within a near future, when the computing power of machines will parallel the human mind, with supposed consequences such as the possibility to download the integrity of the human brain and its conscious state in a machine.[2] If the Singularity University does not openly pursue the goal of merging or replacing human beings with machines, it does offer research programmes in artificial intelligence, robotics and biotechnologies. The philosophical ideas promoted by Ray Kurzweil and his followers might be discarded as extravagant and improbable by many,[3] yet these critiques did not prevent the Singularity University from forming partnerships with powerful institutions and corporations, such as Google Inc. and the National Aeronautics and Space Administration. The involvement of Google as corporate founder of the Singularity University and its recent acquisition of the artificial intelligence company DeepMind Technologies,[4] has raised some criticism and speculation among the press. One of the most important online platforms on art and digital technologies, the mailing list Nettime, discussed the issue among its members. In

1 Singularity University, "Company Overview", accessed June 4, 2014, http://singularityu.org/media-room/#.

2 Ray Kurzweil, *The singularity is near: when humans transcend biology* (New York: Viking, 2005).

3 The ideas and predictions of Ray Kurzweil have been criticized, among others, by philosophers, computer scientists and critical thinkers such as John Searle, Daniel Dennett and Rodney Brooks. See: Ray Kurzweil, Jay Wesley Richards and George F. Gilder, *Are we spiritual machines? Ray Kurzweil vs. the critics of strong AI* (Seattle, WA: Discovery Institute Press, 2002).

4 Samuel Gibbs, "Google buys UK artificial intelligence startup Deepmind for £400m", *The Guardian*, January 27, 2014.

May 2014, the critical theorist and media art specialist Geert Lovink wrote a post titled "Tensions within the bay area elites", to which several prominent art critics such as Florian Cramer and Brian Holmes responded, addressing and discussing a possible hidden agenda within Google and its supposed implications with the Singularity University and transhuman ideology.[5] It is not the first time that the ethical orientation of Google - which has embraced the expression "don't be evil" as its corporate motto – has been called into question. As early as 2007, the Italian hacker collective Ippolito published a book condemning the profit-oriented economical strategies and the underlying privacy-invading mechanics of the famous search engine, pointing out the dangerous hegemonic potentials of the corporation.[6]

The discussion that occurred in the Nettime mailing list is just one example of vibrant debates, within the artistic field, concerning the correlation between scientific research, the implementation of modern technologies and their consequences on society. The 2012 edition of the Transmediale Festival, to mention another example, hosted an exhibition presenting the works of artists that privileged a disruptive attitude toward computers. The exhibition, curated by Jacob Lillemose, was tellingly entitled *Uneasy Energies in Technological Times*. Amid works from artists such as Eva & Franco Mattes, Heath Bunting and Jon Satrom, a fork bomb was depicted on the wall of the exhibition space.[7] A fork bomb is a line of code written in a programming language that has the potential to compromise an operating system, forcing it to run in an endless loop of self-replicating command lines. Often, hackers rival in creating shorter but more efficient fork bombs as a way of manifesting their computer skills. In its simplicity, but also in its disruptive and devastating power, the simple code was regarded by the curator of the exhibition as a suitable artwork.

The previous examples are symptomatic of a diffused tendency in the arts today, which seem to privilege works of digital art that manifest a critical stance towards the

---

5 Geert Lovink, " Tensions within the bay area elites" *Nettime Mailing List*, May 11, 2014, accessed June 4, 2014, http://nettime.org/Lists-Archives/nettime-l-1405/threads.html.

6 Ippolita, *Luci e ombre di google: futuro e passato dell'industria dei metadati* (Milano: Feltrinelli, 2007).

7 The fork bomb presented was depicted by software programmer and media artist Denis Roio, known as Jaromil.

technology used by the artists. If the techno-euphoria is alive and well in the Bay Area, within the new media art field the stance towards new technologies (and in particular towards artificial intelligence and its iconic device, the computing machine) seem to be tainted by a critical position. Certainly, the artistic production cannot be reduced to a single approach. Even within a narrow field such as the new media art one, there are artists, curators and historians that engage in a discourse in which works of computer art opt to focus on the generative properties of the machine and favour an approach that is compliant with computer technologies and the related scientific research. Nevertheless, the subversive approach seems to have gained momentum in recent years within the new media art field, which is made up of a peculiar cluster of actors, events and institutions that focus on the use of new technologies within contemporary artistic production. The word 'new' is often discarded and many refer to the field as simply 'media art' while some critics and historians have argued that the expression 'digital art' is preferable. Although there is no consensus regarding the exact designation of the technologies belonging to new media art, the works included in this kind of production are for the most part associated with the use of computers, digital tools and information technologies. Furthermore, a large number of authoritative voices among this specific field affirm that new media art is separated from what they consider the traditional art circuit.

Subversive Drives: Questions and Origins

Computer-generated art has been traditionally associated with artificial intelligence research, because of its peculiar procedural approach and also because this scientific research was predominantly discussed during the pioneering years of the use of computers in art. Artificial intelligence and the computing machine were generally regarded as the appropriate instruments to explore and understand peculiar human abilities such as intelligence, reasoning and consciousness. The ambitious goals of artificial intelligence are not new: the synthetic reproduction of life has haunted the imagination of many artists, writers, composers and scientists through the centuries. Such aspirations have been portrayed by a variety of works, from antique sculptures to

modern automata, from medieval paintings to contemporary movies. Computer-generated art seems to fit particularly well within this tradition, benefitting from the development of cybernetics, the retailing of personal computers and the development of new theories in artificial intelligence, robotics and artificial life.

It is during the second half of the twentieth century that computer-generated art is recognized as an artistic practice. Margaret A. Boden and Ernest A. Edmonds report that the first use of the term 'generative' in an artistic context was linked to computer graphic and computer art, represented by pioneers such as Michael Noll, Frieder Nake and Georg Nees, with a first occurrence in 1965 during the exhibition *Georg Nees: Generative Computergrafik* at the Technische Hochschule Stuttgart.[8] The German philosopher Max Bense was possibly among the first contributors to take computer-generated art into consideration and propose a methodology to analyse this production within his structuralist aesthetic.[9] Important exhibitions like *Cybernetic Serendipity*, curated by Jasia Reichardt at the Institute of Contemporary Arts in London in 1968, and *Software*, curated by Jack Burnham at the Jewish Museum in New York in 1970, finally presented works of computer-generated art to a larger audience. During the following decades, the number of artists working with new technologies to produce generative art and the number of institutions, festivals, conferences and journals presenting and discussing their works continued to grow.[10] Artists did not only create works, they participated in the discussions regarding the technologies they were using, together with researchers, historians and philosophers. These discussions ranged from aesthetic questions to scientific ones, and further encompassed cultural, political and ethical issues, from the most optimistic positions to the most sceptical and critical ones in respect to the evolution and implementation of modern technologies within society.

If the aspiration to emulate life was conducted by artists and researchers with a shared excitement during the initial years of computer-generated art and until the mid-eighties,

---

8 For a brief history of generative art, see: Margaret A. Boden and Ernest A. Edmonds, "What is Generative Art?" in *Digital Creativity*, Volume 20, Numbers 1-2, March 2009.

9 Max Bense, *Aesthetica: Einführung in Die Neue Aesthetik* (Baden-Baden: Agis-Verlag, 1965).

10 Some significant examples are the *Leonardo* journal (founded in 1968 in Paris) the Ars Electronica festival, (founded in 1979 in Linz), the Transmediale festival (founded in 1988 in Berlin) and ISEA International, the Inter-Society for the Electronic Arts (founded in 1990 in the Netherlands).

artists evolving in this field started to develop a more critical and distanced approach. Sometimes, they expressly used the modern tools of technologies, such as computing machines, robotics and biotechnologies, to create works questioning the ethical, moral and social values of precisely the technologies they were employing. Artists Joan Heemskerk and Dirk Paesmans (Jodi), Paul Vanouse, Natalie Jeremijenko, Oron Catts and Ionat Zurr of The Tissue Culture & Art Project created some exemplary works in this regard. Parallel to the discussion offered by the artists and their works, the question concerning the utility and dangers to society presented by the development of new technologies was vividly discussed by researchers, philosophers and literary theorists.[11] Conferences and panels held at international venues like Transmediale, Ars Electronica and ISEA, offered a common ground for artists, historians and researchers from a variety of fields to share and discuss their ideas.

This study examines some historic examples of computer-generated art to provide an understanding of this production and to offer a possible framework for discussing it today. For what reasons do artists that currently use computing machines, together with the actors involved in the presentation of computer art, seem to favour a subversive and disruptive approach to computer technology and research? Can we identify some key moments that have contributed to shaping computer-generated art in this manner? What are the conventional approaches to discussing computer art? Are they still pertinent today? Additionally, the question of the alleged separation of new media art - to which computer art is associated - from the traditional art circuit will also be considered. The goal is to provide a better understanding of the complex relations and the supposed separation of the two fields, by means of a detailed analysis of key moments related to this assumed divide. Through the examination of selected works, texts and exhibitions, this research intends to provide an understanding of the subversive drives in the present artistic production related to computer-generated art. Furthermore, it will contribute to a better understanding of the complex relations between art and technology on the one hand, and between new media art and contemporary art on the other. Thereby, it aims to resolve a number of questions associated with this type of artistic production that is today a source of ongoing debate.

[11] The works of researchers, philosophers and critical theorists will be discussed in the third chapter.

Methodological Approach

In order to answer the previous questions, it is necessary, as a first step, to consider computer-generated art as an artistic practice in its context. I will examine the role played by artists, curators and institutions as cultural actors in the field of new media art, and more specifically generative art. Consequently, I am adopting a sociological methodology. In this sense, I am referring to the analysis made by Pierre Bourdieu regarding the constitution of the field of cultural production, outlining the important methodological concepts for a sociology of art. As Bourdieu emphasized, artistic production is not independent from external factors, quite the contrary: "it becomes clear that the 'subject' of the production of the art-work – of its value but also of its meaning – is not the producer who actually creates the object in its materiality, but rather the entire set of agents engaged in the field."[12] A field which, as Bourdieu explicitly states, is the result of the combined efforts of artists, critics, collectors, curators, and so forth. As a result, the perception and the study of a work of art require the examination of the field in which the work has been produced. This approach allows me to position the work considered in a broader social, cultural and economical context. Yet, as Bourdieu himself admits, "it is difficult to conceive of the vast amount of information which is linked to membership of a field."[13] It is impossible to account for all the slight influences, relations, gossip and exchanges that contribute to the constitution and the evolution of a specific cultural field, because they are not registered and documented. As a consequence, I have decided to mainly work with specific and selected case studies. Indeed, case studies are more appropriate tools when dealing with qualitative questions and more effective if the field of a research exists in the present moment and is still evolving, which is the case with computer-generated art and new media art.

For the purpose of this thesis, I have decided to focus on three specific cases: the works of pioneering artists Edward Ihnatowicz and Harold Cohen; the writings of researchers

[12] Pierre Bourdieu, "The Historical Genesis of a Pure Aesthetic" in *The Field of Cultural Production: Essays on Art and Literature* (Cambridge: Polity Press, 1993), 261.

[13] Pierre Bourdieu, "The Field of Cultural Production, or: The Economic World Reversed" in *The Field of Cultural Production: Essays on Art and Literature* (Cambridge: Polity Press, 1993), 31.

and artists questioning the validity of the artificial intelligence research, in particular during the eighties and the nineties; and the presentation of computer art at the documenta X exhibition in 1997. The diversity of case studies considered reflects the complexity of the subject and the reality of the cultural field of new media art. They also provide an overview of the evolution of this kind of artistic production through the years. The sources taken into account have been determined by each specific case: analysis of the artworks and related documents, interviews with artists and curators, analysis of texts and documents in the archives of institutions and museums. To further complement my research, I have also been actively visiting and participating in exhibitions and symposiums related to new media art, which provided an invaluable insight into the field and the ongoing debates.

Furthermore, I also refer to the idea of *Performative Kunstgeschichte*, which considers the work of an art historian as being not only analytical but also performative. This approach does not try to hide or disregard the subjectivity of the historian within the cultural field, but rather to assume it as a contributing and enriching element of the research. In Philip Ursprung's words: "als eine Praxis, welche die Bedingungen und Motive der Autoren ins Spiel bringt und der es weniger darum geht, Bedeutung zu fixieren, als darum, sie offen zu halten."[14] The researcher is thus – to associate this approach with the reflections put forward by Bourdieu - part of the cultural field that he investigates. The *Performative Kunstgeschichte* approach considers, furthermore, that the acknowledgement and awareness concerning the subjectivity of the researcher should not lead to a futile attempt to limit or hide his personal position within the field, but rather to expose and to consciously bring the information that such a position offers into the research. My activity as curator and art critic, and the experience that I have collected during my participation in the field of contemporary art and, in particular, new media art, has led me to conclude that the artistic production of computer-generated art should today be re-examined.

In the introduction to the first edition of the *Variantology* collection, cultural and media theorist Siegfried Zielinski claimed that it is necessary to have knowledge of the

[14] Philip Ursprung, "Performative Kunstgeschichte" in *Kunstgeschichte und Gegenwartskunst: vom Nutzen und Nachteil der Zeitgenossenschaft*, ed. Verena Krieger (Köln: Böhlau, 2008), 213.

transdisciplinary field of research associated with a specific production, in this case he is noticeably considering the variety of media art and their related scientific fields.[15] For this reason, and because Zielinski's assertion seems to be shared by the majority of media art critics, I deemed it important to analyse the fundamental ideas developed by researchers in the field of cybernetics, robotics and artificial life when approaching computer-generated art. I will therefore sometimes refer to their basic concepts and ideas. As a guideline to conducting research, Siegfried Zielinski also emphasised the necessity of a purpose. As he affirms, "research that is not also driven by wishes and hopes, belongs to the Hades of academe; it is anaemic and lifeless."[16] Hopefully, the questions addressed will offer a different and original understanding of computer-generated art today and suggest alternative views concerning its discussion and evolution, in comparison to the current and dominant ones regarding this specific type of artistic production.

Chapters and Case Studies

The first chapter addresses the historical and theoretical background of computer-generated art and its development within the new media art field. The historical precedents of current generative art production are briefly presented through a concise history of works created from antiquity to modern times. Subsequently, the definition of generative art is considered through the examination of some of the most frequently recurring ones, provided by prominent artists and historians. The question of emergence, appearing as central in several definitions of generative art, will also be discussed. Theories about emergence therefore constitute the theoretical framework in which works of generative art are more likely to be discussed. The visions and ideas of the most important art critics and historians active in the new media art field and in particular those approaching computer-generated art, contribute to the constitution of a specific narrative in which this type of artistic production is generally analysed and

[15] Siegfried Zielinski, Silvia Wagnermaier and Gloria Custance, *Variantology: On Deep Time Relations of Arts, Sciences, and Technologies* (Köln: W. König, 2005).

[16] Siegfried Zielinski and Silvia Wagnermaier, "Depth of Subject and Diversity of Method - An Introduction to Variantology" in *Variantology: On Deep Time Relations of Arts, Sciences, and Technologies* (Köln: W. König, 2005), 9.

understood. However, the new media art field is regarded as being separate from the traditional art circuit, something that is referred to as the digital divide.[17] Therefore, the most recurring arguments of critics and historians who support the existence of the divide are analysed at the conclusion of the chapter. Ultimately, the purpose of the first chapter is to attempt to constitute a possible framework in order to understand computer-generated art as an artistic production that belongs not only to the specific field of new media art but also to a larger discussion that concerns the relationship between the arts, technology and society.

Chapters two, three and four present the analysis of the specific case studies. The three case studies have been chosen by a set of criteria determined by the subject of the research and its questions. The first case study focuses on two artworks, the second on a theoretical debate and the third on an exhibition and its curatorial choices. The works discussed had to meet the current and broad definition of computer-generated art, while they also had to be sufficiently well known and discussed within the new media art field on an international scale. Since this research intends to provide an understanding of computer-generated art and the subversive tendencies of this form of artistic production today, the consideration of three cases belonging to three different historical moments further provide a variety of sources from which to infer some conclusions. In particular, the analysis of the artist's writings and the analysis of the context of presentation of the works have been taken into account.

In the second chapter, a selection of artworks created in the early seventies will illustrate the production of what are commonly considered the pioneering artists in the field of computer-generated and computer–controlled art. The work *Senster*, by Edward Ihnatowicz, and *Aaron*, by Harold Cohen, are examined in detail. These works were widely discussed at their time and are still referred to as pioneering in recent publications.[18] The chapter considers not only the specificity of these works, their context of presentation and their reception, but most importantly, the artistic goals of

[17] The digital divide discussed here must not be confused with that which concerns the disparity of access to the Internet between rich and poor countries.

[18] See, for example: Paul Brown, "From Systems Art to Artificial Life: Early Generative Art at the Slade School of Fine Art", in *White Heat Cold Logic: British Computer Art 1960-1980* (Cambridge, Mass: MIT Press, 2008).

their authors and their position regarding the scientific research associated with their work.

The third chapter examines the assimilation, within generative art, of the criticism addressed against computers and the artificial intelligence research prompted by the humanities and by part of the scientific community. The question concerning the impact of computing machines on our society, discussed by sociologists, philosophers and researchers, nurtured the debate within the new media art field. What is more, the opposition of bottom-up approaches to top-down approaches, within scientific research, has been especially vivid in this regard. The positions of artists that have been actively discussing these topics, mirrored in the writings of philosophers and critical thinkers, will provide an understanding of some important debates surrounding computer-generated art during the eighties and the nineties. The *Leonardo* journal founded in 1968 in Paris and the festival Ars Electronica in Linz, founded in 1979, are also considered for their role in the evolution and the shaping of the discussion associated with this specific artistic production.

The fourth chapter examines one particular event, namely the constitution of a computer and media art showcase within the documenta X exhibition in 1997, exemplifying the artistic production of computer art at a time when more artists seem to have lost faith in computer technologies. This case study portrays an interesting example of participation by artists making use of computers in an important international contemporary art event. It also coincides with the constitution and recognition of new media art as a distinct field of artistic production. Additionally, the analysis of the participation of the artistic collective JODI within the tenth documenta exhibition provides an example of computer-generated art that differs greatly from the pioneering works discussed in the second chapter.

In the concluding chapter, possible explanations about the reasons behind the current subversive tendencies in computer-generated art are deduced from the analysis of the cases discussed in chapters two, three and four. I will discuss the current perspective on computer-generated art and question whether it is still appropriate in light of my

findings. Subsequently, I will discuss the alleged separation between new media art and the traditional art circuit and I will attempt to offer an unconventional perspective on this particular question. Computer-generated art exemplifies the problematic and often ambiguous relationship between the new media art field and the traditional art circuit, on the one hand, and the dialogue between the arts, modern technologies and society, on the other. This research will hopefully offer alternative perceptions and open up new debates regarding this kind of artistic production, in addition to providing a better understanding of the works examined and their context of presentation and discussion. What is more, this study illustrates a thrilling history of opposing visions and opinions on how to contribute to the enlightenment of society through art and technology, and on whether this is the goal art should pursue.

Chapter 1

1.1 Computer-Generated Art and Its Multiples

Computer-generated art is frequently associated with a restricted group of works produced using computing devices and sophisticated algorithms, written in programming languages such as *processing* and *vvvv* that have been specifically conceived for graphic and artistic creation. The algorithms in question are habitually referred to as evolutionary or generative algorithms.[19] The great majority of these works, which are presented through video screenings, interactive installations and in printed or sculpted form, are abstract in nature. Artists Karl Sims, Christa Sommerer and Laurent Mignonneau, Kenneth Rinaldo and, more recently, Aaron Koblin or Casey Reas are commonly associated with this type of artistic production and are credited with having brought it to international recognition.

Computer-generated art is a specific example of generative art: the two terms are sometimes used interchangeably, although generative art doesn't necessarily require the use of computing machines per se. In fact, generative art - considered in its literal and broader definition - is a very old and varied artistic production, preceding the invention of a programmable electronic machine. Artists and theoreticians working with generative procedures acknowledge the long established heritage of this practice in art. Philip Galanter, artist, curator and researcher, teaching graduate studies in generative art and physical computing at Texas A&M University, affirmed: "Generative art didn't start with computers, and I don't think it will end there either."[20] In the following section, I will briefly consider the history and the variety of this artistic production in order to better understand its heritage and its recent development.

---

[19] For a description of the programming languages used to create generative art, see, for exemple: Casey Reas and Chandler McWilliams, *Form+code in design, art, and architecture* (New York: Princeton Architectural Press, 2010); Matt Pearson, *Generative Art: A Practical Guide Using Processing* (Shelter Island, NY: Manning, 2011).

[20] Philip Galanter, "Generative art is as old as art", *artificial.dk*, September 6, 2004, accessed March 29, 2010, http://www.artificial.dk/articles/galanter.htm.

1.2 An Open History of Generative Art

While several narratives related to generative art could be written, according to the perspective one wishes to highlight, the story of generative art is traditionally regarded as exemplary of the prolific intersections between art, science and technology. A good number of current works in generative art use computing machines and programming languages. For this reason, it has been customary to inscribe this type of artistic production within the history of mechanical sculptures and automata.

Automata have been produced in different countries and civilisations since antiquity. In their extensive publication edited in 1949, Alfred Chapuis and Edmond Droz analysed in depth the history of automata.[21] According to the two historians, Heron of Alexandria is among the most significant forerunner of cybernetics principles and automata, in antiquity.[22] His experiments with air, steam and water pressure enabled him to produce spectacular animated devices and surprisingly life-like sculptures for theatres and temples. In Arabia, during the Middle Ages, Haroun-al-Rachid, also known as Al-Jazari, pursued the research in mechanical engineering and developed water powered clocks and automata.[23] In Europe, mechanical clocks appeared during the fourteenth century and were often flanked with automated bronze figures counting the full hours, the Jaquemarts. The art of animating clocks with automated figures spread across the continent throughout the centuries. A significant example is Strasbourg cathedral's astronomical clock, which was constructed between 1838 and 1848 by Jean-Baptiste Schwilgué, who replaced the ancient clock with a more complex and accurate mechanism and a variety of new figures and calendars.[24]

But automata were not only associated with clocks. During the seventeenth century, the Italian family De Francini, from Florence, were invited to decorate the grottos of the

---

21 Alfred Chapuis and Edmond Droz, *Les Automates. Figures Artificielles D'hommes Et D'animaux. Histoire Et Technique* (Neuchâtel: Editions du Griffon, 1949).

22 Chapuis and Droz (1949), 33.

23 Ibn-Al-Razzaz Al-Jazari, *The Book of Knowledge of Ingenious Mechanical Devices* (Dordrecht: Reidel, 1974).

24 See the description written by the son of the artist: Charles Schwilgué, *Description Abrégée De L'horloge Astronomique De La Cathédrale De Strasbourg* (Strasbourg: Dannbach, 1856).

Château Saint-Germaine-en-Laye, in France, which they adorned with water powered fountains and automata.[25]

The golden age of automata, with an increased production and complexity of automated animals, writing and drawing children, talking maidens and chess players, flourished during the baroque epoch. The digesting duck created by Jacques de Vaucanson, supposedly not only imitating the natural movements of a duck but its digestive system as well, is probably the most famous and somehow mythical example. Jacques de Vaucanson, who created two other spectacular automata and dreamed of reproducing an artificial man displaying the entire circulatory system, was also responsible for the modernization and mechanization of tailoring manufacture.[26]

In Switzerland, Pierre Jaquet-Droz, his son Henri-Louis and their collaborator Jean-Frederic Leschot, created a large number of extremely complex automata that are still admired today. One of their most sophisticated creations, *The Writer*, is composed of more then six thousand pieces.[27]

The French philosopher René Descartes is also credited with having built an automata so true to reality that when discovered by the captain of the boat in which it was being shipped, it was thrown into sea because of the fear it raised. The story is probably a legend, but it is commonly recounted to portray the growing interest in the artificial imitation of life and the speculation concerning a mechanical approach to life and nature in modern times. An example is the controversial essay by Julien Offray de La Mettrie, *L'Homme Machine*. Not surprisingly, the author mentions the automata created by Vaucanson to document his description of the human being as a complex machine.

> Vaucanson, who needed more skill for making his flute player than for making his duck, would have needed still more to make a talking man, a mechanism no longer to be regarded as impossible, especially in the hands of another

[25] Chapuis and Droz (1949).

[26] For a description of the works of Vaucanson and his biography, see: André Doyon, Bertrand Gille, and Lucien Liaigre, *Jacques Vaucanson: Mécanicien De Génie* (Paris: Presses univ. de France, 1966).

[27] See: Pierre Jaquet-Droz, *Les Oeuvres Des Jaquet-Droz: Montres, Pendules Et Automates (Musées et collections privées)* (La Chaux-de-Fonds: Imprimerie Courvoisier, 1971); Charles Perregaux, *Les Jaquet-Droz et Leschot* (Neuchâtel: Attinger, 1916).

Prometheus.[28]

The history of automata is not limited to Europe: in Japan, mechanical puppets capable of serving tea, the Karakuri Ningyo, were being created since the seventeenth century and are part of a longer tradition of handcraft production of anthropomorphic puppets used for ritual and ceremonies.[29]

The automata are also the ancestors of modern computing machines, a heritage that finds a first illustrious inventor in Joseph-Marie Jacquard, who further developed the mechanism invented by Jacques de Vaucanson, by creating what is considered to be the first programmable machine with punched cards, the *Métier Jacquard*. In turn, the *Métier Jacquard* served as inspiration to Charles Babbage who conceived the analytical engine, which could have been the first mechanical general-purpose computer, had Babbage received enough support and funding to complete it.[30]

In the concluding chapter of their extensive investigation on automata, Alfred Chapuis and Edmond Droz briefly consider this kind of production in the twentieth century. They also mention the ongoing research of cyberneticists Norbert Wiener, Warren Sturgis McCulloch, and William Ross Ashby - who provide a mechanist model of the functioning of the brain - suggesting that their research might open new developments in the building of future automata. Chapuis and Droz further consider the hypothesis that automata could one day imitate nature to the point that they ought to be considered as living creatures. They nevertheless sustain that automata will always be subjugated to the intelligence of men and that "no element of this intelligence can apparently be conveyed to a machine."[31] However, the authors conclude that the work of automata developed through the centuries should be admired for its contribution to the present development of technology and the industry.

---

[28] Julien Offray de La Mettrie, *Man a machine*, translated by Gertrude C. Bussey and Mary Whiton Calkins (Chicago: Open court publishing co., 1912), 140-141.

[29] See: Jane M. Law, *Puppets of Nostalgia: The Life, Death, and Rebirth of the Japanese Awaji Ningyo Tradition* (Princeton, N.J: Princeton University Press, 1997).

[30] For a description of the Analytical Engine and its history, see: Doron Swade, *Charles Babbage and His Calculating Engines* (London: Science Museum, 1991); D S. Halacy, *Charles Babbage, Father of the Computer* (New York: Crowell-Collier Press, 1970).

[31] "La moindre parcelle de cette intelligence ne semble pas pouvoir se transmettre à la machine." Chapuis and Droz (1949), 400, my translation from the French.

In the twentieth century, the production of automata was associated with the invention of electricity and the possibilities of telecommunication. French researcher Jean-Claude Heudin includes the production of utilitarian robots in his long history of 'artificial creatures', stressing that the highest achievements in robotics were dictated by utilitarian and economic imperatives.[32] In 1927 Engineer Roy James Wensley created the Televox robot for the Westinghouse Electric and Manufacturing Company, a robot capable of executing simple tasks and that could be remotely controlled by telephone.[33] Televox belongs to a long series of robots whose purpose is to present and celebrate the technological achievements of the corporation financing them. Half a century later, in 1986 the Honda Motor Company developed Asimo, who was advertised as the world's most advanced humanoid robot, embodying the continuing fascination for the automation of movement. Similar to the automata made by the Jaquet-Droz, which were an elaborate means of advertising their clocks and pendulums, Asimo fits the Honda Corporation's mobility campaign perfectly, although the creators insists that "the main concept behind Honda's robot R&D was to create a more viable mobility that allows robots to help and live in harmony with people."[34]

Other machines were created in the laboratories and associated with research in cybernetics, such as the *Machina Speculatrix* by William Grey Walter, first created in 1948, and *Shakey*, developed during the sixties by the Stanford Institute of Research. Ordinary robotic machines, such as mechanical arms have also been used in industrial production since the first acquisition of the Unimate 001 by General Motors in 1962. At the end of his historical survey, Heudin analyses several recurring arguments opposing the development of research in robotics and the quest for the creation of artificial life. He dismisses these arguments as being "the translation of a more general technophobia or of a timeless conservatism."[35] According to the French researcher, the ongoing

---

[32] Jean-Claude Heudin, *Les Créatures Artificielles: Des Automates Aux Mondes Virtuels* (Paris: O. Jacob, 2007).

[33] For a description of Televox, see: Herbert F. Powell, " Machines That Think ", *Popular Science Monthly*, January (1928): 12-13, accessed December day 2014, http://cyberneticzoo.com/robots/1927-televox-wensley-american.

[34] *Asimo: Technical Information* (Bangkok: Asian Honda Motor, 2007).

[35] "la traduction d'une technophobie plus générale ou d'un conservatisme hors d'âge" Jean-Claude Heudin, *Les Créatures Artificielles: Des Automates Aux Mondes Virtuels* (Paris: O. Jacob, 2007), 429,

implementation of robots in our society is the prelude of an inevitable evolution in which men and machines will peacefully coexist and collaborate.

The fascination for automata and the possibility to imitate life-like behaviours through mechanical objects is thus an obsession that runs through the centuries and not only in western culture. Today, a large variety of robots exist: spectacular objects of entertainment and advertising such as Asimo are probably the closest product to the general representation of what a robot should be and look like. But the example of Honda's Asimo is also interesting for the way it highlights the relationship between the production of modern automata for commercial purposes and the cultural field of new media art. Indeed, Asimo was among the stars of the Ars Electronica festival in 2010, which dedicated a series of public presentations supplemented by screenings and panels relating the achievements of Honda's research in robotic mobility.

If the history of automata leads to the recent developments in cybernetics and robotics, while allowing artists to experiment with these technologies, the history of generative art is not restricted to the production of mechanical sculptures and devices. Generative practices are not only found in works of visual arts, they are found in a variety of different artistic productions that range from architecture to music to literature.

In the eighteenth-century, composer and music theorist Johann Philipp Kirnberger experimented with the possibilities of using mathematical and casual rules to generate music,[36] leading to the practice of the *Musikalisches Würfelspiel*, a system to compose minuets and polonaises with the use of a dice. The Musical Dice game has fascinated many composers since the end of the eighteenth century, but the experiments to compose with casual and accidental elements is not limited to the use of dice: the famous sonatas and interludes for prepared pianos created by John Cage are a renowned example in contemporary music.[37] Eventually, music composition integrated the use of computing machines and a growing number of music theorists and composers further

---

my translation from the French.

[36] Kirnberger, Johann Philipp. *Der allezeit fertige Polonoisen- und Menuettencomponist* (Berlin: Christian Friedrich Winter, 1757).

[37] John Cage, Sonatas and interludes for prepared piano (1946-48), CD.

developed experiments with the use of computational and generative practices.[38] The *Illiac Suite*, created in 1955-56 by Lejaren Hiller and Leonard Isaacson, is considered the first composition in this regard by Gerhard Nierhaus, computer music professor at the University of Music and Performing Arts Graz.[39] In his wide-ranging examination of algorithmic composition, Nierhaus describes a great variety of applications of algorithmic procedures in music, dividing the different sections of his research into scientific disciplines such as chaos theory, cellular automata and artificial intelligence. For example, David Cope, with his *Experiment in Musical Intelligence*, programmed a computer to imitate works of illustrious composer and autonomously generate new works.[40] Andrew Horner and David Goldberg applied the principles of genetic algorithms to create musical scores. Peter M. Todd experimented with artificial neural networks[41] while Peter Beyls was among the first to compose music by using cellular automata.[42] Joseph Nechvatal, finally, composed his *viral symphOny* (2006) with the use and the application of generative algorithms and computer viruses.[43] Nierhaus sustained that "virtually all procedures used for tasks of algorithmic composition have their origins in extra-musical fields, and often become highly popular outside the purely academic study of these disciplines."[44]

In literature, examples of compositions that are linked to generative principles are found in the cut-up technique, consisting of cutting pre-written texts from books and newspapers and reassembling the single words and sentences in an accidental way. The dadaist Tristan Tzara introduced this technique in his "dada manifesto on feeble love and bitter love."[45] Later, beat generation writers William Burroughs and Brion Gysin made large use of the cut-up technique, in particular in their collaborative work *The Third Mind*.[46] In addition, Burroughs and Gysin developed the permutation poems, using computers to generate all the possible results offered by the multiple distributions

[38] A comprehensive survey of music composition through algorithmic computation is provided by Gerhard Nierhaus, *Algorithmic Composition: Paradigms of Automated Music Generation* (Wien: Springer, 2009).
[39] Nierhaus (2009), 238-239.
[40] Nierhaus (2009), 122-127.
[41] Nierhaus (2009), 214-217.
[42] Nierhaus (2009), 195.
[43] Joseph Nechvatal, *Viral Symph0ny* (Institute for Electronic Arts, 2006), CD.
[44] Nierhaus (2009), 264.
[45] Tristan Tzara, "dada manifesto on feeble love and bitter love" *391*, December 12, 1920: 47-49.
[46] William S. Burroughs and Brion Gysin, *The Third Mind* (New York: Viking Press, 1978).

of the words within a sentence. Together with Antony Balch, Burroughs also produced a short film using the same principle: *The Cut-Ups* (1966). In her extensive analysis of the history and aesthetic of the cut-up technique in literature, Sigrid Fahrer emphasised the defiant and destructive qualities of this practice and considered it a paradigm of postmodernism:

> In its destructive potential, which although tamed is nonetheless persistent, the Cut-up generates Entropy in the information theory sense. (…) In this reflection of ambiguity and indifference, the Cut-up appears as a postmodern paradigm.[47]

Fahrer's observations regarding the cut-up technique in literature seem to challenge the common perspective that considers generative approaches, applied in artistic production, in light of a long established constructive relationship between art and technology.

Generative practices are found in architecture, as well. From the legendary origins of the Corinthian capital to modern organic architecture, nature has always played an inspiring role. During the second half of the twentieth-century, the evolutionary forms of nature appealed to architects, who were interested in using the computing power of machines to analyse and reproduce these forms through specific algorithms. Nicholas Negroponte, co-founder of the MIT Media Lab, was an enthusiastic forerunner in the use of computers within the field of design and architecture. Most of his works reflect on the opportunities to apply artificial intelligence to architecture, and on the potential to foster a dialogue between the architect and the machine, as in his project URBAN5. Negroponte was persuaded that machine intelligence is necessary in the implementation of computer-aided design, because:

> An environmental humanism might only be attainable in cooperation with machines that have been thought to be inhuman devices but in fact are devices that can respond intelligently to the tiny, individual, constantly changing bits of information that reflect the identity of each urbanite as well as the coherence of the city.[48]

---

47 "In seinem destruktiven Potenzial, das zwar gezähmt, aber vorhanden ist, vermag Cut-up eine Entropie im informationstheoretischen Sinn zu erzeugen. (...) In dieser Reflektion von Ungewissheit und Indifferenz erscheint Cut-up als Paradigma der Postmoderne" Sigrid Fahrer, *Cut-up: Eine Literarische Medienguerilla* (Wurzburg: Konigshausen & Neumann, 2009), 203-204, my translation from the German.

48 Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment* (Cambridge, Mass: The MIT Press, 1970), 5.

Negroponte regarded the implementation of machine intelligence in architecture as a way to foster a humanistic approach. In his view, machines must be capable of learning and evolving in order to effectively contribute to architecture, instead of simply performing automatized tasks. In a similar way, architect and researcher John Frazer, professor at the Architectural Association in London, applied the principles of cellular automaton and evolutionary algorithms in the creation of architectural tools and prototypes over the course of many decades of research, from his first experiments with the *Reptile structural system* in 1968 to the more elaborate project *Universal Interactor* in 1991. According to Frazer, evolutionary architecture "will conserve information while using the processes of autopoiesis, autocatalysis and emergent behaviour to generate new forms and structures."[49] The vocabulary employed by Frazer to describe his work largely employs the scientific jargon associated with artificial intelligence, robotics and artificial life. More recently, a variety of architects have been experimenting with a large array of generative tools such as evolutionary algorithms and swarm intelligence to create new forms and develop new architectural techniques of construction. Examples are R&Sie (n)+D, Morphosis, Kokkugia, Gramazio & Kohler (ETH).[50] In particular, Gramazio & Kohler developed an approach, which they termed 'Digital Materiality' that uses computer and robot-arms to create a synthesis between the material and the digital world. They carried out a series of experiments in the construction of walls and modules, by adding or subtracting materials. In one particular example, *The Resolution Wall* (2007), they made use of generative algorithms aiming to optimize both the fabrication time and the solidity of the structure, letting the computer evolve and learn from previous constructions in order to create new and unpredictable patterns of bricks.[51]

In Italy, the application of generative principles in architecture have been developed since the eighties by architect and professor Celestino Soddu, who created a software based on evolutionary algorithms that produces architectural models of edifices and cities. Together with Enrica Colabella, Celestino Soddu founded the Generative Art

[49] John Frazer, *An Evolutionary Architecture* (London: Architectural Association, 1995), p. 103.
[50] See the examples presented in: Casey Reas, Chandler McWilliams and Jeroen Barendse, *Form+code in Design, Art, and Architecture* (New York: Princeton Architectural Press, 2010).
[51] Fabio Gramazio and Matthias Kohler, *Digital Materiality in Architecture* (Baden: Müller, 2008).

Conference in 1998, with the purpose of creating a platform for generative art and all its varied productions, not only inviting architects but also artists, musicians and historians to present and discuss their works and research. The Generative Art Conference is still held today, each year in a different location in Italy, and is one of the few international events dedicated exclusively to generative art. Celestino Soddu presented the vision and goals behind the organization of the international conference with the following terms:

> Generative Art is a way to think and to design. Following this approach we can find, united by the same enthusiasm, architects and mathematicians, poets and musicians, physicists and semioticians, philosophers and painters, engineers and designers.[52]

Quite significantly, Soddu stresses the interdisciplinary potential of generative art allowing for collaboration among researchers and artists from a variety of fields.

The role played by computers in the development of generative art in music and architecture has been significant. However, computing machines and robots were not the only possible way of creating generative works of art, some notable examples can be found in painting and sculpture. The *frottages* by Max Ernst, the *Métamatics* machines generating abstract works by Jean Tinguely, the *Condensation Cube* by Hans Haacke (1963–65), the expanded polyurethane sculptures by César and Damien Hirst's *Making Beautiful Drawings* (1993) could all be included in a large history of generative art. Indeed, all these works present a technique or a system that generate unpredictable results, as a consequence of the peculiar procedure set in motion by the artist. Generative processes are still used today in artistic production and are found in works that encompasses a variety of techniques including internet-based practices, interactive works and even biotechnologies.

To further extend the frontiers of generative art, one should mention some experiments developed by researchers outside the arts. Their influence on artistic production and their conceptual and aesthetic qualities have had such an impact in the new media art field that they have been presented widely in art festivals, museums and publications. With time, these projects have been regarded as works of art in their own right. A

[52] Celestino Soddu, "Introduction to Generative Art '98", *Generative Art proceedings of the 1998 Milan First International Conference Generative Art '98* (Milan: Librerie Dedalo, 1998), 5.

notable example is the *Tierra* project, started in 1989 by ecologist and researcher Thomas Ray, a computer simulation based on artificial life principles.[53] Another example is the work *Evolved Virtual Creatures* (1994) by computer graphic scientist Karl Sims, a research project on the application of genetic algorithms in the evolution and interaction of virtual creatures.[54] Although these works were mainly research projects to simulate evolutionary properties in artificial creatures, they became iconic examples within artistic production and were repeatedly presented in artistic venues and publications.

This brief historical overview reveals that generative approaches in art are an old practice that still exists and continues to evolve today. Furthermore, it shows that generative art has very often been regarded as an artistic production that exemplifies the intersection between art, science and technology. During the second half of the twenty century, generative approaches in art have been largely associated with research in artificial intelligence and robotics, while the artists who exploited computers to produce works of art have been exploring the generative possibilities offered by computing machines. The relationship between computers and generative approaches has been so strong, that generative art has been used as a general term to simply describe the use of computers in art in the emerging years.[55] Nevertheless, the definition of the distinctive attributes characteristic of a work of generative art is an ongoing debate.

1.3 Recurring Definitions and the Concept of Emergence

While art historians and critics have mostly examined the position of computer-generated art within the dialogue between the arts and science, many artists, architects and musicians actively involved in this field have proposed and discussed a variety of

---

53 The Tierra project is presented in several articles by Thomas Ray, see for example: Thomas Ray, "An evolutionary approach to synthetic biology: Zen and the art of creating life" in *Artificial Life 1* (Cambridge, MA: MIT Press, 1994), 195-226.

54 See the presentation of the research in the article: Karl Sims, "Evolving Virtual Creatures" in *SIGGRAPH '94 - Proceedings*, July 1994: 15–22.

55 Margaret A. Boden and Ernest A. Edmonds, "What is Generative Art?" in *Digital Creativity*, Volume 20, Numbers 1-2, March 2009.

definitions of generative art. The most frequently argued definition today is probably the one offered by Philip Galanter, artist and professor at Texas A&M University.

> Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art.[56]

The definition proposed by Galanter has been cited in many publications and papers on generative art. It has the advantage of clearly defining the requirements of a work to be generative while, at the same time, being quite broad in scope. According to this definition, a work of generative art can be made of any material and can represent anything, as far as it has been produced using a system that functions in a procedural way with some degree of autonomy. If the definition doesn't specify the necessary characteristics of the resulting work of art, it prescribes some necessary qualities to the system, which must be of a procedural sort and work with a degree of autonomy. Gallanter is not restrictive about the nature of the system itself, any system that the artist builds or chooses to work with could be used to create generative art: from computing machines, to a set of rules of natural language. A large production of works is inscribed in this definition, from the most recent works of digital art to the previously mentioned work by Jean Tinguely and Hans Haacke, for example.

Artist, art critic and curator Thomas Petersen, founder and co-editor of the online magazine on net and computer art *artificial.dk* offers a similar definition:

> The defining trait of generative art is rather that the artist establishes a system, which can generate a number of possible forms rather than one single finished form.[57]

The definition stresses again the procedural method and the use of a system in order to generate forms. On the other hand, Petersen explicitly mentions the fact that the system can produce more than one form, which is something worth mentioning, considered that many artists commonly use a single system to produce a large number of artworks.

---

[56] Philip Galanter, "What is Generative Art? Complexity theory as a context for art theory" in *International Conference on Generative Art* (Milan: Generative Design Lab, Milan Polytechnic, 2003).

[57] Thomas Petersen, "Special: Generative art", *artificial.dk*, June 9, 2004, accessed February 21, 2012, http://www.artificial.dk/articles/generativespecial.htm.

Curiously, this definition suggests the exclusion of systems that are built to generate one single result, albeit a generative one. Such works are possible and exist: the *Condensation Cube* by Haacke, for example, once sealed and installed in the museum space will generate one single work, although an evolving one. For this reason, it is, in my opinion, clear that Petersen is mostly thinking about computer-based generative art for his definition.

Marius Watz, artist and curator of *Generator.X* - a platform created in Oslo in 2005 with exhibitions, concerts and symposiums focusing exclusively on generative art - proposed an analogue definition, which clearly emphasizes the use of modern and digital technologies:

> Generative art is an art practice where the artist creates a system, typically a piece of software, which is either used to create a work of art or constitutes a work of art in itself. Generative art describes a method or strategy, rather than a specific style or medium of work. The form of Generative Art that most people are aware of is software-based visual abstract art, with artists like C.E.B. Reas, Lia, Jared Tarbell etc. being the most visible exponents. This work is abstract, visually complex and non-representational. Typically, it will be purely digitally generated, with no "natural" origin.[58]

Although Watz does not exclude other possibilities and alternative 'systems' from his definition, he puts emphasis on the fact that generative art is today associated with software-based art. The artist also stresses that generative works are mostly abstract and visually complex. His definition has therefore the merit of offering a qualitative description of works of generative art. Another point worth mentioning is that Watz regards both the output produced by the system and the system itself, as part of the work.

Although most of the definitions and criteria for examining generative art are put forward by artists involved in this kind of artistic production, the issue has also been explored by some important media art critics. Invited to open the first conference of *Generator.X,* Susanne Jaschko, art historian and former co-director of *Transmediale*, acknowledged the recent application of the concept of generative art to a stricter

[58] Marius Watz, "Generative Art and Generator.X – A Talk with Marius Watz" in *Digital Tools,* September 20, 2005, accessed February 21, 2012, http://www.digital-tools-blog.com/interview/12-generative-art-and-generatorx-a-talk-with-marius-watz.

context, namely the use of computing machines, evolutionary algorithms and digital programs to produce works of abstract art. Susanne Jaschko proposed an interesting analysis of this artistic production and provided an alternative definition.

> However, because this conference intentionally presents a more focused understanding of generative art, and one that I would like to pursue and enlarge upon, I come up with another, stricter, definition which we can discuss further later on, as this won't be the only definition of generative art that will be presented in this conference. In this definition, generative art refers to an art practice where the artist creates a process by the means of a computer program executed by the machine itself. The so-created process is characterized by some degree of autonomy and selforganization and can result in various manifestations capable of providing an aesthetic experience.[59]

In her talk, Jaschko acknowledges the limitation of using the expression generative art to such a strict spectrum of production and mentions the broader definition proposed by Galanter. Yet, she engages in some aesthetic considerations within this stricter perspective. Jaschko distinguishes between the code written to generate the work and the graphical output of the work, affirming in turn that both can be considered as part of the work of art. On the one hand, she considers that the code could be appreciated for its elegance: "In generative art, the medium and material is the code, which is supposed to be designed elegantly."[60] On the other hand, she stresses that the spectator can rarely appreciate the code and its elegance, either because it won't be presented to the public or because the spectator doesn't have the capability to decipher and read it. The output of the work, be it a video screening or a digital print, is what most viewers will experience of the work. From this premise, Jaschko questions whether this aspect of the work is purely retinal, that is to say, whether it appeals exclusively to the senses instead of stimulating the intellect. She acknowledges that generative art is double in nature and necessitates appreciation not only of the visual output, but also of the underlying code generating the work of art and thereby concludes that the main output of a generative work is indeed retinal. The definition put forward by Jaschko - although limited in this context to the kind of generative art mainly concerned with software-based works - is extremely interesting, because it identifies the dual nature of a generative work of art,

---

[59] Susanne Jaschko, "Process as aesthetic paradigm: a nonlinear observation of generative art" at the *Generator.x* conference, 23 - 24. September 2005, Oslo, Atelier Nord, accessed March 5, 2012, http://www.generatorx.no/20051115/text-process-as-aesthetic-paradigm-a-nonlinear-observation-of-generative-art/#more-312.

[60] Jaschko (2005).

where both the system and the output are part of a single work, but where each of them need to be appreciated with a very distinct act of perception and aesthetic judgment. If the code needs to be appreciated for its conceptual elegance, the output needs to be appreciated for its formal properties. Jaschko inscribes the works of generative art in the "long history of art that is dedicated to sensory perception and that will always exist as a parallel to conceptual art."[61] Regarding the restricted field of generative art taken into account in her survey, Jaschko adds: "unfortunately, the emphasis on sensory perception continues to keep it out of the core of the media art discourse. Its closeness to design is as suspicious as its widespread neglect of media critique or self-reference that is so popular within media art."[62] These considerations are extremely important: they not only offer criteria for the evaluation of generative art but they also offer some reflections concerning the status and the perspectives of this production within the new media art field.

The provocative argument put forward by Jaschko primarily addresses artistic productions that strongly focuses on generative approaches. She affirms that works of generative art might be as complex and elaborated as the codes that underlie the works, but their results, the visual outputs, are less interesting or indeed altogether uninteresting from a conceptual point of view. However, in her analysis there is also an underlying critique addressing the media art field itself. Following Jaschko's reasoning, the current media art community seems to favour 'media critique' and 'self-reference', to use her words, instead of works that focus on generative procedures, elaborated codes and 'retinal' outputs.

If Jaschko is right, we might infer that there is significant pressure on artistic production to discard generative approaches in the traditional sense, that is to say, approaches that focus on procedural systems and formal results. In this respect, British artist Matt Pearson offers some reflections that seem to manifest the will to bridge the gap between the retinal and the conceptual qualities. In his practical guide to generative art, he contemplates the definition proposed by Galanter and, even though he does not refute it, he expresses his dissatisfaction with it:

[61] Jaschko (2005).
[62] Jaschko (2005).

> Although this is accurate and descriptive—and a long sentence with all the right words—a single phrase like this isn't enough. I don't think it quite captures the essence of generative art (GenArt), which is much more nebulous. In my mind, GenArt is just another by-product of the eternal titanic battle between the forces of chaos and order trying to work out their natural harmony, as expressed in a ballet of light and pixels.[63]

Pearson seems more interested in grasping the hidden forces behind generative art and offers a less technical definition, considering more the aesthetic and philosophical aspects behind generative art. In turn, he proposes another possible definition:

> Generative art is neither programming nor art, in their conventional sense. It's both and neither of these things. Programming is an interface between man and machine; it's a clean, logical discipline, with clearly defined aims. Art is an emotional subject, highly subjective and defying definition. Generative art is the meeting place between the two; it's the discipline of taking strict, cold, logical processes and subverting them into creating illogical, unpredictable, and expressive results.[64]

This definition is particularly interesting because it associates the specific artistic qualities of generative art with the subversion of the mechanical and rational properties of the system used. In this case, Pearson considers generative art associated with the production made using computing machines, although he later concedes that generative art could be produced with any kind of autonomous system such as a mechanical one, a game of chance, a natural phenomenon, or even a subconscious human behaviour. It is also worth noting that the author considers generative art as the meeting point between art and programming, confirming a general vision that regards computer-generated art as a discipline that bridges the arts and the sciences. While he stresses the importance of an intuitive comprehension of generative art, Pearson nonetheless adds some more objective properties. Among the list of properties offered by Pearson, one is worth mentioning in particular: generative art is "an exercise in extracting unpredictable results from perfectly deterministic processes."[65] This is, in fact, a distinctive characteristic of emerging systems and it is not a coincidence that Pearson, in his book, dedicates a chapter to the question of emergence as well.

---

63 Matt Pearson, *Generative Art: A Practical Guide Using Processing* (Shelter Island, NY: Manning, 2011), 3.
64 Pearson (2011), XVIII.
65 Pearson (2011), 12.

Emergence is a concept that many other artists and critics dealing with generative art have recognised and acknowledged its playing an important role in their research. Artist and theoretician Mitchell Whitelaw, for instance, considered emergence as crucial to these groups of works: "emergence is central to artificial life. It is the concept that explains the crucial leap it makes between non-life and life."[66] Furthermore, Whitelaw suggests that emergence is what drives an artist to create works of artificial-life and even what makes these works worthy of being considered within an artistic approach. This is possibly the strongest thesis in his research:

> I will argue that emergence is not merely central to the mechanics of a-life practice but represents its primary interest and its dominant drive, that emergence is to a significant extent the reward that draws artists to use a-life.[67]

The concept of emergence appears in almost every essay discussing works of generative art. It recurs in several definitions of generative art and it is regarded by many as the ultimate goal and driving force for artists engaging in this kind of production. Because artists and historians deem the concept of emergence as being critical to understanding and evaluating works of generative art, it is therefore important to examine this concept in detail. Emergence is an essential concept in many scientific and humanistic disciplines as it is, for instance, in cognitive sciences, in the philosophy of mind and in biology. It is defined in the Oxford Companion to Philosophy with the following description: "A property of a complex system is said to be 'emergent' just in case, although it arises out of the properties and relations characterising its simpler constituents, it is neither predictable form, nor reducible to, these lower-level characteristics."[68]

The concept can be traced back to Aristotle. In his considerations of the relationship between form and matter in the book H of Metaphysics, the Greek philosopher observes that in some specific cases "the whole is something over and above its parts, and not just the sum of them all."[69] This very simple definition might be regarded as the most

---

66 Mitchell Whitelaw, *Metacreation: Art and Artificial Life* (Cambridge, Mass: MIT, 2006) 207.
67 Whitelaw (2006), 208.
68 *The Oxford Companion to Philosophy*, ed. Ted Honderich (Oxford, New York: Oxford University Press, 2005), 239.
69 Aristotle and David Bostock, *Aristotle Metaphysics: Books zeta and eta* (Oxford, England: Clarendon Press, 1994), 39.

general description of the basic property of emergence. The description offered by Aristotle is nonetheless very general and the concept evolved over the course of the last century with contributions from both philosophers and researchers. In an article relating to the history and key concepts of emergence, philosopher Jaegwon Kim traces the origins of modern emergentism back to John Stuart Mill.[70] While observing the results of the chemical combination of two substances producing a third substance with different properties - different from the two substances but also from the combination of the two - the British philosopher and economist concludes that this phenomenon applies to other complex agents in nature:

> If this be true of chemical combinations it is still more true of those far more complex combinations of elements which constitute organised bodies and in which those extraordinary new uniformities arise which are called the laws of life. All organised bodies are composed of parts similar to those composing inorganic nature and which have even themselves existed in an inorganic state, but the phenomena of life which result from the juxtaposition of those parts in a certain manner bear no analogy to any of the effects which would be produced by the action of the component substances considered as mere physical agents.[71]

Not only does Mill apply the phenomenon of emergence to more complex organisms, he also considers life as an emerging property that cannot be explained by mechanical laws alone. It is George Henry Lewes, however, who is usually acknowledged with having clearly defined and used the term emergence: "the emergent is unlike its components insofar as these are incommensurable, and it cannot be reduced to their sum or their difference."[72] Jaegwon Kim argues that emergence became a popular concept applied to many disciplines, from biology to neurophysiology, as a result of the ideas of philosophers John S. Mill, G. Henry Lewes, followed by the so-called British emergentists Samuel Alexander and Conwy Lloyd Morgan. However, he believes that the British philosophers from the beginning of the twentieth century were compromised by the concept of vitalism.[73] In particular, if applied to the explication of life, as Conwy Lloyd Morgan admits, "it is pretty sure to be said that to speak of an emergent quality of

---

[70] Jaegwon Kim, " Making Sense of Emergence ", in *Essays in the Metaphysics of Mind* (Oxford: Oxford University Press, 2010), 8.

[71] John S. Mill, *The Collected Works of John Stuart Mill, Volume VII - A System of Logic Ratiocinative and Inductive, Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation (Books I-III)* (Toronto: University of Toronto Press, 1963), 371.

[72] G. Henry Lewes, *Problems of Life and Mind* (London: Trübner, 1875), 412.

[73] Jaegwon Kim, "Making Sense of Emergence", in *Essays in the Metaphysics of Mind* (Oxford: Oxford University Press, 2010), 8-9.

life savours of vitalism."[74] According to Kim, the association of the concept of emergence to vitalism is the reason why philosophers of the twenty-century quickly discarded it. It is only in recent times that emergence was again considered in a new light by younger philosophers, especially in the effort to explain problems related to the body-mind separation within a physicalist approach. In his attempt to classify and illustrate the variety of approaches on emergence, Robert Van Gulick distinguishes between metaphysical relations and epistemic relations. Within the first group, he further distinguishes emerging properties from emergent causal powers and suggests that there is a variety of degrees of radicalism from the weakest kind of emergence to the most radical one where, supposedly, "the whole has features that are both 1. different in kind from those had by its parts, and 2. of a kind whose nature and existence is not necessitated by the features of its parts, their mode of combination and the law-like regularities governing the features of its parts."[75] Van Gulick seems sceptical about the existence of such radical kinds of emerging properties and causal powers, believing that it would challenge some fundamental physicalist assumptions. This disbelief, however, does not belong to the research in artificial intelligence, as the ambition to create life-like behaviours from an artificial system seems to rely precisely on the possibility of this radical kind of emergence.

Indeed, the concept of emergence has been influential within the scientific research that evolved from cybernetics. The faith in the possibility of strong emergence has been a compelling drive for artificial intelligence research and emerging behaviours have been predicted from the start. Herbert Simon expected that "machines will be capable, within twenty years, of doing any work that a man can do" and Marvin Minsky agreed, stating that "within a generation ... few compartments of intellect will remain outside the machine's realm - the problem of creating 'artificial intelligence' will substantially be solved."[76] These bold predictions implicitly assumed the emergence of behaviours commonly associated to human beings within an artificial system, such as intelligence,

---

[74] C L. Morgan, "Emergent Evolution: The Gifford Lectures", Delivered in the University of St. Andrews in the Year 1922 (London: Williams and Norgate, 1923), 12.

[75] Robert Van Gulick, "Reduction, emergence and other recent options on the mind-body problem: a philosophic overview" in *Journal of Consciousness Studies* n.8, 2001: 17.

[76] Such predictions are related by Daniel Crevier, *AI: The Tumultuous History of the Search for Artificial Intelligence* (London and New York: Basic Books, 1993), 109.

semantic understanding and even conscious thinking. Partly responsible for the proliferation of such speculations was the article written by mathematician Alan Turing describing a possible test, today known as the 'Turing test', to resolve whether or not a machine could be considered intelligent.[77] The article generated a vast literature not only in computer science but in philosophy as well,[78] and provided a concrete goal for many researchers in the field.

Although the concept of emergence has not always been explicitly employed by AI researchers, it was nevertheless embedded in their visions and predictions. It is in more recent fields of embodied robotics and artificial life, that the concept of emergence became particularly important. Rodney Brooks, developer of the 'subsumption architecture model', a biologically inspired approach in robotics, considers that intelligent capabilities "arise from the interaction of perception and action, and that getting these right was the key to more general intelligence."[79] American computer scientist Christopher Langton, who organized the first International Conference on the Synthesis and Simulation of Living Systems at the Los Alamos National Laboratory in 1987, while introducing the expression 'artificial life', clearly affirms the significance of the concept of emergence: "Artificial Life starts at the bottom, viewing an organism as a large population of *simple* machines, and works upwards *synthetically* from there (...). The 'key' concept in AL is *emergent behaviour*."[80]

The new-born field of artificial life, which would have an even greater influence on artistic production than artificial intelligence, was largely relying on the research by Chilean biologists Humberto Maturana and Francisco Varela. In their theory of *autopoiesis*, the nervous system is presented as a result of an emerging process:

> The nervous system emerges in the phylogenetic history of living beings like a network of special cells (neurons), which is embedded in the organism in such a

[77] Alan M. Turing, "Computing Machinery and Intelligence" in *Mind: a Quarterly Review of Psychology and Philosophy* n.59 (1950): 433-460.

[78] One of the most significant examples of a reaction against the 'Turing test' is the article by philosopher John Searl in which he presents his 'Chinese room argument': John Searl, "Minds, Brains and Programs", *Behavioral and Brain Sciences* n.3 (1980): 417-457.

[79] Rodney A. Brooks, *Robot: The Future of Flesh and Machines* (New York: Allen Lane, 2002), 37.

[80] Christopher G. Langton, "Artificial Life", in *Artificial Life: The Proceedings of an Interdisciplinary Workshop on the Synthesis and Simulation of Living Systems, Held September, 1987, in Los Alamos* (Redwood City, Calif: Addison-Wesley Pub. Co., Advanced Book Program, 1989), 2.

> way that it couples points in the sensory surfaces with points in the motor surfaces.[81]

If the concept of emergence has been analytically discussed by philosophers and applied by researchers of different fields to explain and justify their research, it is today a concept that still fascinates as much as it generates opposing positions. Science historian George Dyson illustrates quite vividly the problematic ambiguity related to the concept of emergence at the end of the twenty-century:

> The emergence of life and intelligence from less-alive and less-intelligent components has happened at least once. Emergent behavior is that which cannot be predicted through analysis at any level simpler than that of the system as a whole. Explanations of emergence, like simplifications of complexity, are inherently illusory and can only be achieved by sleight of hand. This does not mean that emergence is not real. Emergent behavior, by definition, is what's left after everything else has been explained.[82]

Confused and varied as it might be, the concept of emergence had a strong impact on artistic production, as already acknowledged by Mitchell Whitelaw. Several artists creating generative works of art were confronted with the concept of emergence and even contributed to it with their own ideas and observations. Among them, Australian artist Simon Penny, mostly known for his interactive robotic artworks, largely contributed to the theoretical discussion about emerging properties and the opposition between top-down and bottom-up approaches. In a recent article, revisiting the rise of artificial life practices in new media art in the late eighties, he recalls a general intellectual inclination toward the concept of emergence among artists at that time:

> A general desire was to capture, harness or simulate the generative and 'emergent' qualities of 'nature'— of evolution, co-evolution and adaptation. 'Emergence' was a keyword in the discourse.[83]

Jane Prophet, the artist who created the interactive works *TechnoSphere* (1995) and *Swarm* (1997), explicitly affirmed her debt to artificial life research. In an article co-written with computer scientist Mark d'Inverno, she offers a personal view on the concept of emergence:

---

[81] Humberto R. Maturana and Francisco J. Varela, *The Tree of Knowledge: The Biological Roots of Human Understanding* (Boston: Shambhala, 1992), 163.

[82] George Dyson, *Darwin Among the Machines: The Evolution of Global Intelligence* (Reading, Mass: Addison-Wesley Pub. Co, 1997), 9.

[83] Simon Penny, "Twenty years of artificial life art", *Digital Creativity* 21, no.3 (2010): 197.

> There has been a great deal of debate about what constitutes emergent systems, but they are typically described as having some kind of order, structure or intelligence that is not pre-determined. In our view emergence is related to scale and observation, and the conflict which arises between our different understandings at the micro- and macrolevels.[84]

Although it is more a comment then a definition of emergence, the artist concedes that the attribution of an emerging behaviour is, in reality, to a certain extent dependent to the subject observing the events. Later in the article, Jane Prophet admits that her means to create emerging systems in her work follows a bottom-up approach, which has been decisive to the research in both embodied robotics and artificial life.

The concept of emergence plays a central role in the works of many other important figures of new media art engaging in generative processes. Louis-Philippe Demers and Bill Vorn, collaborating together to create impressive robotic installations, affirm: "the perceived emergent behaviours of these machines produce a multiplicity of meanings based on single dynamic pattern of events."[85] Christa Sommerer and Laurent Mignonneau, famous for their applications of evolutionary algorithms in the creation of artificial life art installations, believe that "when a set of evolving autonomous particles or agents interact, the resulting global system displays emergent collective properties, evolution and critical behaviour having universal characteristics."[86] Furthermore, the concept of emergence is fundamental to the work of Roy Ascott, who experimented with the possibilities opened by the application of telematics in art. Ascott's visionary ideas, sometimes tinted with esoteric elements, envision the emergence of a global culture and the appearance of a collective intellect.

> When sensibilities from diverse cultures from all parts of the globe interweave, collaborate, conjoin, and become restructured, new cultural forms emerge, new potentials for meaning and experience are brought forth.[87]

---

[84] Mark d'Inverno and Jane Prophet, "Creative conflict in interdisciplinary collaboration" in *Interaction: Systems, Theory and Practice*, ed. Ernest Edmonds and Ross Gibson (Broadway, N.S.W.: Creativity & Cognition Studios Press, University of Technology, 2004), 251-270.

[85] Louis-Philippe Demers and Bill Vorn, "No Man's Land" in *Memesis: Die Zukunft Der Evolution = the Future of Evolution: Ars Electronica Festival 96, 2.-6.9.1996, Linz, Austria* (Linz: Ars Electronica, 1996), 264.

[86] Christa Sommerer and Laurent Mignonneau, "Modeling the Emergence of Complexity: Complex Systems, the Origin of Life and Interactive On-Line Art" in *Leonardo* 35, no.2 (2002): 163.

[87] Roy Ascott, "Gesamtdatenwerk: Connectivity, Transformation, and Transcendence" in Roy Ascott and Edward A. Shanken, *Telematic Embrace: Visionary Theories of Art, Technology, and*

Roy Ascott is interested in the networking of humans through the development of new technologies; he promoted a society based on 'connectivity', a concept that often recurs in his writings, which is at the base of his vision of emergence, encompassing not only the behaviour of a single man or a single machine, but society as a whole. The work and the writings of the British artist reflect the ambitious goal to merge art and modern technologies in order to move society forward.

And so, artists engaging in generative practices have investigated the philosophical concepts associated with artificial intelligence, artificial life and robotics, in order to deepen their artistic research, as exemplified by their speculation on and their application of the concept of emergence. The concept of emergence, important in many scientific disciplines, seems to have provided a suitable bridge to finally connect the arts and the sciences. It also allowed for the constitution of a specific production within the arts that critics, curators and historians could approach under one narrative. This production, associated with the application in an artistic context of approaches related to artificial intelligence, artificial life, robotics and sometimes biotechnologies to create emerging behaviours, belongs to the specific field of new media art.

1.4 A Common Narrative: Bridging the Arts and the Sciences

Generative art is characterized by a variety of media, approaches and techniques: the multiplicity of definitions and the diversity of ideas concerning its key aspects, such as the concept of emergence, reflect the variety of works that have been created under the term generative art. The manufacture and retail of personal computers, video cameras and other digital devices, made this technology available and affordable for artists who wanted to experiment with them, facilitating the establishment of a unique artistic field at the threshold of art and technology. The term 'new media art' used to designate this field, is a recent one: many current art historians and critics concerned with this type of artistic production recognise its application, though they admit its ambiguity. The term 'new' within the label 'new media art' is probably the most problematic element. For

Consciousness. (Berkeley: University of California Press, 2003), 223.

Christiane Paul, a leading curator and historian in the field of digital art, "what is in fact new is that digital technology has now reached such a stage of development that it offers entirely new possibilities for the creation and experience of art."[88] With time, new media art has developed its own cluster of festivals, exhibitions, museums, publications and PhD programmes,[89] together with the emergence of notable artists, critics and curators. Nevertheless, many professionals working in this field regret the limited exchanges and interactions between new media art and the traditional art world. To take the example of generative art, there is no subject entry for this production in important art dictionaries and encyclopaedias like The Dictionary of Art[90] and the Lexikon der Kunst.[91] Generative art is equally absent from the Oxford Art Online database.[92] Indeed, generative art is almost exclusively discussed in publications specifically dedicated to new media and digital art.

Inscribing a variety of works into one narrative is a delicate task, not deprived of problems. Works such as the *Senster*, a cybernetic sculpture by Edward Ihnatowicz, *A-Volve*, an interactive software-based installation by Christa Sommerer and Laurent Mignonnau, and *MEART*, a project created with the use of biotechnologies by the SymbioticA laboratory, differ regarding the techniques employed, but they also share some fundamental similarities, such as the attempt to investigate emerging properties. Delineating narratives within the history of art is a common and recurring effort among art historians; on the other hand, some artists have been reluctant to accept their inscription in such narratives. Harold Cohen, for example, even if universally described as a pioneer in the field of computer art, always refused to be labelled as a computer artist and explicitly distanced himself from the work of his colleagues associated with the same kind of production.[93] Oron Catts, artistic director and co-founder of the SymbioticA laboratory at the University of Western Australia, similarly addresses the question of outlining narratives within art history: while he recognizes the relationship

88 Christiane Paul, *Digital Art* (New York: Thames & Hudson, 2003), 7.
89 Some examples are the Ars Electronica Festival in Linz, Transmediale in Berlin, Zentrum für Kunst und Medientechnologie in Karlsruhe and the international Ph.D. research programme CAiiA-STAR.
90 Jane Turner, *The dictionary of art* (New York: Grove, 1996).
91 *Lexikon der Kunst* (Leipzig: E.A. Seemann, 1987-1994).
92 *Oxford Art Online*, Accessed January 31, 2014, http://www.oxfordartonline.com.
93 Concerning the refusal to be associated to the computer art movement, see: Harold Cohen, "Off the Shelf" in *The Visual Computer* 3/86 (Springer International, 1986).

between bio-art and artificial life, he refuses to associate his research with the work carried out by former artificial life artists.[94] Nevertheless, several historians addressing new media art seem inclined to situate the work of artists investigating generative approaches that they associate with the research in artificial intelligence, artificial life and biotechnologies within one narrative.

In his encompassing publication *Information Art* - today a point of reference concerning the intersection of art, science and technology - artist and Professor Stephen Wilson presents a large variety of artists and works associated with scientific research. The chapters are divided according to the different disciplines: biology, physics, mathematics, kinetics, telecommunication and digital information. Computer-based generative art is in particular analysed in the fourth chapter, presenting works of algorithmic art, genetic art and artificial life, although works of robotics and artificial intelligence are analysed in other chapters as well. In his introduction, Wilson mentions the separation of the two cultures stated by Charles Percy Snow and affirms that his book "seeks to revisit the relationship of art to scientific and technological research (…) and the prospects for future mutual influence."[95] According to Wilson, artists can contribute to research because of their alternative ways of approaching problems and because they "can function as an independent zone of research."[96] But in order to do so, artists "must become curious about scientific and technological research and acquire the skills and knowledge that will allow them to significantly participate in these worlds."[97]

Christiane Paul takes a similar stance. In the chapter addressing themes in digital art - such as artificial intelligence, artificial life and telerobotics - the media art historian and curator affirms that many artists working with these technologies have been influenced by the ideas of researchers such as Norbert Wiener and Richard Dawkins. She also considers that the artistic projects in artificial life can contribute to a better understanding of the nature of life and intelligence.

---

94 See: Oron Catts and Ionat Zurr, "The Ethics of Experiential Engagement with the Manipulation of Life" in *Tactical Biopolitics: Art, Activism, and Technoscience*. ed. Beatriz Da Costa and Kavita Philip (Cambridge, Mass: MIT Press, 2008).

95 Stephen Wilson, *Information Arts: Intersections of Art, Science, and Technology* (Cambridge, Mass: MIT Press, 2002), 5.

96 Wilson (2002), 36.

97 Wilson (2002), 39.

> All the previously mentioned artificial-life projects point to the possibility that computers may not only help us to understand the structures of ideas, the nature of intellectual processes, but they may very well change these very processes and the way we think.[98]

By discussing some examples of artificial life, Christiane Paul suggests that the artistic productions involved with the use of computers not only provide a link between the arts and the sciences, but through research they also contribute to the body of knowledge within this field.

The Italian art historian Gianna Maria Gatti identifies the roots of artificial life at the end of the sixties, within the research on neural networks and artificial intelligence.

> Artists operating in the sphere of Artificial Life also make reference to neural networks. (...) The fact that these nets are inspired directly by the brain - by a part of the body of the living organism - makes them count among the models of Artificial Life. Their origin, however, can be traced to Artificial Intelligence research.[99]

Eventually, Gianna Maria Gatti incorporates the recent artistic production by means of biotechnologies in the tradition of artificial life, thus providing an encompassing narrative that spans from the earlier artistic research in artificial intelligence to the recent works of bio-art. Gatti regards the artistic production made with electronic and digital technologies - to which she includes computer art, virtual realities, telerobotics and net.art – as a means to "undertake a closer dialogue with the sciences and therefore confront oneself with more specific expertise, with other methodologies: an interexchange that makes itself reciprocal."[100] According to Gatti, the marriage of art and science is the most efficient way to contribute to knowledge and the progress of mankind. The communication between men and machines can, in her opinion, further contribute to this progress.

Artificial life is the focus of the research by art historian and artist Mitchell Whitelaw, who provided a comprehensive compilation and cataloguing of different works of this kind. Whitelaw traces the origins of these works in cybernetics and artificial intelligence

---

98 Christiane Paul, *Digital Art* (New York: Thames & Hudson, 2003), 145.
99 Gianna Maria Gatti, *The Technological Herbarium* (Berlin: Avinus Verlag, 2010), 45.
100 Gatti (2003), 36.

research, mentioning artists such as James Seawright, Thomas Shannon, and Edward Ihnatowicz as their predecessors. Whitelaw also uses the general terms of new media art within which he inscribes this artistic production. He describes the significance of new media as follow:

> New media art provides a venue for the transformation and translation of the technical and conceptual artifacts of artificial life into cultural objects – conglomerates of rhetoric, metaphor, and aesthetics. (…) The interface of artificial life and cultural practice is particularly significant for all these reasons: it opens a space for creative experimentation and debate around the increasing technologization of living matter as well as broader issues of life and autonomy, agency and evolution, genetics, code and matter.[101]

Along with Christiane Paul and Stephen Wilson, Whitelaw considers new media art – and artificial life in particular - important because of the opportunity it offers to discuss, from a cultural perspective, the growing importance and the application of new technologies in our society and in our lives.

Oliver Grau inscribes the artistic research related to virtual reality within a tradition of artistic production that originated with the phantasmagoria spectacles.

> Considered in this light, a number of contemporary artists can be found working today in the tradition of the phantasmagoria, a hybrid between art, science, and the magic.[102]

While he mostly describes the development of virtual reality, Grau ends his historical overview with a section dedicated to artificial life, mentioning the works of artists Christa Sommerer and Laurent Mignonneau, Thomas Ray, Karl Sims and Berndt Lintermann. He inscribes the works of these artists within the narrative that he has drawn from the phantasmagoria spectacles of the late eighteenth century onward. In his opinion, the peculiarity of artificial life is to create an interactive image space powered by a genetic algorithm in order to generate the illusion of a biologically populated space. Through the concept of phantasmagoria, Oliver Grau provides thus a link that encompasses artificial intelligence, artificial life and virtual reality into a possible narrative.

---

[101] Whitelaw (2006), 6.

[102] Oliver Grau, "Remember the Phantasmagoria! Illusion Politics of the Eighteenth Century and Its Multimediale Afterlife" in *Media Art Histories* (Cambridge, Mass: MIT Press, 2007), 154.

Edward Shanken, a prominent new media art critic and historian, acknowledges a long tradition of artistic production dedicated to the imitation of life-like behaviours, linking automata and cybernetics to recent experiments in artificial life art.[103] In his publication for the prestigious *Phaidon* edition, the popular collection Themes and Movement, the author groups under the chapter "Bodies, Surrogates, Emergent Systems" artists such as Edward Ihnatowicz, Karl Sims and Eduardo Kac, thus classifying them under what he considers a 'thematic stream' of works related to a variety of scientific concepts and disciplines.

> Complementing art research on robotics and artificial intelligence, artists have embraced the relatively new field of artificial life. (...) Building on similar and related ideas, art research with theoretical foundations in cybernetics, autopoiesis, emergent behaviour and artificial life was vitalized in 1990s, when it became possible to run simulations of evolutionary systems, such as Tom Ray's Tierra program, on a personal computer.[104]

Shanken concludes his short survey of the artistic creations that attempts to imitate life by affirming that "electronic media have begun to cross the threshold between silicon-based systems and biological systems, instigating public dialogue about the social implications of biotechnology."[105] According to the American historian, biotechnologies are a further and complementary step within the new media art tradition of discussing and reproducing life-like behaviours.

Similarly, German art historian Ingeborg Reichle discovers in the earlier artistic experiments with artificial life, robotics and artificial intelligence the origins of recent applications of biotechnologies in art. Reichle considers the highly controversial access of techno sciences to 'genetic makeup' and affirms that the "multifaceted relations between art and science range from critical interrogation of ethically highly controversial technologies of the life sciences, to the artistic endeavour to acquire the science laboratory for the production of art."[106] What is more, for Reichle "the use of

---

[103] See: Edward A. Shanken, "Hot to bot: Pygmalion's lust, the Maharal's fear, and the cyborg future of art" in *Technoetic Arts: A Journal of Speculative Research* 3, no.1 (2005).
[104] Edward A. Shanken, *Art and Electronic Media* (London: Phaidon Press, 2009), 41.
[105] Shanken (2009), 42.
[106] Ingeborg Reichle, *Art in the Age of Technoscience: Genetic Engineering, Robotics, and Artificial Life in Contemporary Art* (Wien: Springer, 2009), 63.

laboratory methods has opened up new means of expression for art, and at the same time has transformed our ideas of laboratories as places dedicated only to the production of knowledge."[107] Reichle pinpoints thus as 'multifaceted' the approach to scientific research permitted to artists: on the one hand, the access for artists to laboratories and tools associated to life science allows for new creative experiments, while on the other it also provides some first-hand knowledge for a critical positioning of these technologies within the artistic discourse.

To provide a narrative is to provide a framework to consider works, texts and events in a particular light. Art historians seem to have favoured the constitution of narratives, creating bridges between artists, works and events, and eventually providing personal and innovative visions of the history of a particular movement or genre. But creating narratives is also a problematic exercise: it is not surprising that many artists and historians, as already mentioned, strongly criticize this approach, correctly pointing out that the constitution of a narrative is always the result of a subjective lecture of the events examined. While it is essential to keep in mind that every narrative is inevitably subjective, to consider a selection of works within one possible narrative is, nevertheless, an approach that allows for hypothesis and considerations on a broader spectrum and thereby offers a wider understanding of a specific artistic production.

The previous examples - describing the ways prominent art critics and historians have decided to group the works of artists that engage with artificial intelligence, artificial life and even biotechnologies together - further illustrate that among some of the most influential actors in the field of media art, some bridges and similarities between artistic positions have been recognized. There are indeed many analogies between the works that will be discussed in the following chapters: all rely on the use of computing machines and the possibilities of imitating or reproducing behaviours commonly associated with living beings. Furthermore, all are characterized by systems that have some degree of autonomy and that produce results that are to some extent unpredictable, be it in terms of movement, form or behaviour. This last characteristic is particularly significant for generative art and is commonly associated to the concept of emergence,

[107] Reichle (2009), 63.

previously discussed. What is more, the majority of critics and historians have conceded that generative art offers the opportunity to create a link between the arts and the sciences. On the one hand, they affirm that this kind of artistic production allows for contributions to scientific research, by developing similar or alternative models of understanding life. On the other, they consider that the artists involved in the use of technologies associated with artificial intelligence, artificial life and life science, are in a favourable position to discuss, question and comment on scientific research. In conclusion, it seems that the majority of critics, curators and historians discussing new media art - and in particular the works associated with the narrative of generative art – deemed this artistic production significant because of the possibility it provides to discuss the sciences and technology outside of their respective fields or, to use a recurring metaphor, to bridge the gap between the humanities and the sciences.

1.5 The Digital Divide

Many influential art historians and critics were keen to write a narrative that links works of computer and generative art to research in artificial intelligence, artificial life and biotechnologies. This specific cluster of works that share the use of computer and generative principles to create emerging behaviours are part of the media art field. It is in the exhibitions, festivals, institutions and publications dedicated to new media art that one is likely to find references and discussions about generative art. But what are the relations of this specific form of artistic production to the field of contemporary art? This question has occupied art historians and critics involved with new media art since the consolidation of this particular field in the nineties and is still highly debated today.

Indeed, there seems to be a general consensus that new media art is separated from the contemporary art field. A recent article published by Claire Bishop on Artforum, bearing the suggestive title "Digital Divide", explicitly discusses this position. While emphasising the lack of interest for new and digital media in the traditional circuit of contemporary art, the author supports the thesis that a divide between media art and the traditional contemporary art field exists. In her words: "There is, of course, an entire

sphere of ‘new media’ art, but this is a specialized field of its own: It rarely overlaps with the mainstream art world."[108] In turn, Edward Shanken affirms that "rarely does the mainstream art world converge with the new media artworld. As a result, their discourses have become increasingly divergent."[109] In a publication examining new media art, the Italian art critic Domenico Quaranta asserts that new media art constitutes an autonomous and independent field, with respect to the contemporary art world.

> All that we weren’t able to explain so far can be explained with a simple theorem: the expression ‘New Media Art’ denotes a ‘world of art’ that is completely autonomous and independent from the contemporary art world and from any other ‘world of art’.[110]

These few examples illustrate how some of the most important critics and curators engaged in media art today seem to agree that there is a separation between the field in which they work and the traditional contemporary art field. However, they don't simply acknowledge this divide, they also offer arguments in order to explain it. What are the arguments that are commonly put forward, in this sense? Among the arguments, a recurring explanation that is almost unanimously endorsed is the lack of market for new media art, what I propose to define as the ‘economic argument’. The fact that there are very few dedicated galleries creating a market for works of new media art is considered a significant factor in its difficulty with gaining access to the traditional art world. In addition, because of their digital or technological nature, media artworks are particularly difficult to sell as a commodity, in particular to art collectors interested in the speculative value of an artwork. Therefore, media art is largely cut off from the commercial circuit of art, which allegedly plays an essential role in the traditional contemporary art field. In the article that clearly affirmed the divide separating digital, media art from the traditional field of art, Claire Bishop proposed the following economic argument: "Yet the hybridized solutions that visual art is currently pursuing - analog in appearance, digital in structure - seem always biased toward the former, so

---

[108] Claire Bishop, "Digital Divide: Contemporary Art And New Media", *Artforum,* September 2012, 436.

[109] Shanken, Edward A., "Contemporary Art and New Media: Toward a Hybrid Discourse?", accessed October 11, 2013: https://hybridge.files.wordpress.com/2011/02/hybrid-discourses-overview-4.pdf.

[110] "Tutto quello che non siamo ancora riusciti a spiegarci finora, può essere spiegato con un semplice teorema: che l'espressione New Media Art identifichi un 'mondo dell'arte' totalmente autonomo, e indipendente sia dal mondo dell'arte contemporanea, sia da ogni altro 'mondo dell'arte'." Domenico Quaranta, *Media, New Media, Postmedia* (Milano: Postmedia books, 2010), 21, my translation from the Italian.

favoured by the market."[111] Bishop supports her argument by stressing that visual art and its market are inherently attached to intellectual property and physicality. Digital art, in her opinion, challenges this basis and could, eventually, overthrow the practices of art collection relying on physical and identifiable objects. The economic argument has been mentioned many times before to justify the separation of digital based works from the traditional art field. In 1998, as net-art practices were starting to gain international attention, Isabelle Graw published an article in *Texte zur Kunst*, an edition dedicated to media art, in which she stressed the difficulty faced by net-art when trying to enter the traditional market of contemporary art: "Another favourite topic is the difficult merchantability of netart. The dominance of the financial imperatives is again the reason why this artistic scene is largely self-organized."[112] Hence, Isabelle Graw not only affirmed the difficulty of artists working with new medias to sell their works, but she also attributed the dominance of the market in the traditional contemporary art field as the reason why media artists are obliged to create their own field. Some years later, in 2005, as the excitement for net-art at the turn of the century started to fade, a prominent media art critic, Geert Lovink, suggested that the lack of market for media art is a reflection of a general lack of interest from critics, historians and the public in the specific field of media art: "In the case of new media arts there was - and still is - no market, no galleries, few curators and critics, and no audience."[113] During a conference at Ars Electronica in 2007, the art historian Verena Kuni, who has been critically involved in mapping and analysing net-art at the turn of the century, further developed the question of the link between economic necessities and web-based art to explain their difficulties in entering the traditional circuit.

> A further fundamental problem is that the political and economic strategies of museums cannot, or can only in part, be applied to Web-based art. Institutions like the Walker discovered that Web-based art did not help boost local pull, and hence visitor numbers, utilizable for procuring subsidies. Private collectors and galleries, whose importance for museum politics is continually on the increase not just in the Anglo-American world, quickly realized that the classical

[111] Bishop (2012), 441.

[112] "Ein weiterer beliebter Topos ist die schwere Verkäuflichkeit von Netzkunst. Dass der Komplex Finanzierung dominiert, ist erneut darauf zurückzuführen, dass diese Szene weitgehend selbst organisiert ist." Isabelle Graw, "Man sieht, was man sieht. Anmerkungen zur Netzkunst" *Texte zur Kunst*, December 1998, 22, my translation from the German.

[113] Geert Lovink, "New Media, Art and Science: Explorations beyond the Official Discourse" in *Empires, Ruins + Networks: The Transcultural Agenda in Art* ed. Scott McQuire and Nikos Papastergiadis (London: Rivers Oram Publishers, 2005).

> principle of up-valuing through placement in museums and/or museum exhibitions has little relevance for Web- based art.[114]

In her article, Verena Kuni principally focuses on presenting the difficulties that she faced while engaging in digital culture from a historical perspective. Among the reasons cited, the economic difficulties of the digitally based artistic production played a role. But the art historian adds an important element to the economic argument that presents the difficulties faced by artists that wish to sell their works. In addition, Kuni stresses the complex relationship between private galleries and collectors, on the one hand, and the public institutions such as museums and contemporary art spaces (supposedly independent from the market) and their need for public funding on the other. If the private galleries and collectors rely on the visibility of works in public spaces to enhance their value, the public institutions rely on the number of visitors to obtain subsidies. The art historian concludes that in this entangled, strategic game, web-based artworks have been eventually left aside. The argument by Verena Kuni brings thus a wider and more complex perspective to the economic argument supporting the digital divide.

The economic argument is also put forward by Domenico Quaranta, who affirms that "unfortunately, among the various typologies of connoisseurs that New Media Art has, art collectors have always been a rare commodity."[115] That is to say, collectors are not interested in investing in works of new media art. The Italian media art critic, although concordant with the economic argument, points out that some examples of galleries and fairs associated with media art have nevertheless been created. In his opinion, therefore, the economic argument alone cannot justify the digital divide.

Edward Shanken also supports the economic argument and recognizes the intricate and influential game of interconnections that bind private and public institutions to the art market.

> It is no surprise that the flow of capital in the art market exerts tremendous

[114] Verena Kuni, "Why I never became a net art historian" in *Net Pioneers 1.0: Contextualizing Early Net-Based Art* ed. Dieter Daniels and Gunther Reisinger (Berlin: Sternberg Press, 2009), 193.

[115] "Purtroppo, tra le varie tipologie di estimatori che la New Media Art ha avuto, i collezionisti sono sempre merce rara." Domenico Quaranta, *Media, New Media, Postmedia*. ibid. 129, my translation from the Italian.

> influence on MCA discourses, through systemic interconnections between artists, galleries, journals, collectors, museums, biennials and art fairs, critics, and art schools.[116]

Not only does Shanken stress the influence of the market on the traditional mainstream contemporary art field, (MCA in his text) he also considers this influence as an important reason for the exclusion of media art from the traditional field: "the contemporary art market remains tightly tethered to more or less collectible objects, and the vast majority of works acquired are painted canvases."[117]

If the economic argument is the most recurring argument in explaining the digital divide, another argument that is often proposed concerns the lack of competences to approach media art among the important actors within the traditional contemporary art field, what I propose to define as the 'competence argument'. The argument can be summarized as follows: because a critical discourse on new media art necessitates a particular knowledge of its history and its techniques, the art historians and critics that are trained within the traditional contemporary art field lack the capacities to approach new media art works, hence they tend to ignore this specific artistic production in their curatorial or critical approaches. This argument is strongly supported by Simon Penny, an artist who produced notable works that exploited principles of embodied robotics and who is also very active from a theoretical perspective in discussing this kind of artistic production. In 2005, he published an article in which he asserted the necessity for art historians and curators to acquire specific competences in order to approach media art.

> Inasmuch as the work discussed in this paper is quintessentially interdisciplinary, it follows that in order to discuss this work in a satisfactory way, historians and scholars must have a similar breadth of training and experience as the practitioners they study. The kind of art criticism typified by the connoisseurship model is inappropriate and inadequate here. It is not sufficient to address such works by passive assessment of them as static aesthetic artifacts, as has been the case with more conventional treatments of 'new media art'.[118]

---

[116] Shanken, Edward A., "Contemporary Art and New Media: Toward a Hybrid Discourse?", accessed October 11, 2013: https://hybridge.files.wordpress.com/2011/02/hybrid-discourses-overview-4.pdf.

[117] Ibid.

[118] Simon Penny, "Bridging Two Cultures: Towards an Interdisciplinary History of the Artist-Inventor and the Machine-Artwork." in *Artists As Inventors, Inventors As Artists* ed. Dieter Daniels and Barbara U. Schmidt (Ostfildern, Germany: Hatje Cantz, 2008), 142-157.

In this passage, Penny clearly affirms the inadequacy of traditional historical and aesthetic approaches while implicitly suggesting a lack of specific competences in the traditional art world. He calls for the constitution of an appropriate aesthetics that would provide art historians and critics with the suitable tools to understand new media art. On the other hand, and this is the singularity of his argument compared to the one offered by other media art critics, he also suggests that media art should be separated from the traditional art world.

> Such works seldom fit in the conventional cultural milieu of the museum/gallery/private collection, but are often immersed in a radically new kind of dispersed digital simultaneity – the net. (...) As such, as I have argued in the past such work demand the development of a new branch of aesthetics: what I have called the aesthetics of behaviour.[119]

This rather unique call for a separation of fields is pertinent to his argument, since a separation of fields would, in Penny's opinion, guarantee an appropriate degree of competence of the actors involved.

The separation of new media art from the traditional art world is discussed in an influential publication printed in 2006, *At the Edge of Art*, by Joline Blais and Jon Ippolito. The title itself tackles the idea of a distance between the artistic approaches discussed in the book and the traditional concept of art. The competence argument surfaces in this book, as well. Regarding the separation of the fields, the authors point to the actors of the traditional art world who, in their opinion, are responsible for not including the new practices in their accounts: "what's holding the art world back is a philosophical laziness: a disinterest in or - worse - a refusal to rethink their definitions of the art they spend so much of their time trying to scare up."[120]

Edward Shanken, again, supports an analogous argument focusing on the lack of competences among the majority of art historians and critics. He also adds some further considerations.

> But the use of these terms in MCA literature typically lacks a deep understanding of the scientific and technological mechanisms of new media, the critical discourses that theorize their implications, and the interdisciplinary

[119] Penny (2008), 142-157.
[120] Joline Blais and Jon Ippolito, *At the Edge of Art* (London: Thames & Hudson, 2006), 232.

> artistic practices that are co-extensive with them. Similarly, mainstream discourses typically dismiss NMA on the basis of its technological form or immateriality, without fully appreciating its theoretical richness, or the conceptual parallels it shares with MCA.[121]

The American art historian, on the one hand, highlights the lack of competences within the mainstream contemporary art (MCA) preventing the appreciation of the technological and scientific background of new media art (NMA). On the other, he suggests that mainstream art critics commonly fail to appreciate the deeper and richer conceptual qualities of many new media art works, a reason, in his opinion, why they are rarely interested in these works. If Shanken agrees with other media art critics that a lack of competences is detrimental to fully appreciating the new media art works, on the other he invites traditional art critics to nevertheless appreciate the conceptual qualities of these works. His position, therefore, is less radical than the one proposed by Simon Penny and suggests that the divide could ultimately be bridged, despite the deficiency of specific competences.

The lack of commercial interest in new media art works and the lack of competences in the traditional art field to approach media art, are without doubt the most recurring arguments used to justify the digital divide. In addition to these two main arguments, a few other arguments have been proposed. The German art historian Verena Kuni explained the difficulty of approaching digital and media art from a historical perspective. As she points out, the difficulty is mostly due to the rapid evolution of the technologies and the practical difficulty of viewing, documenting and archiving works created in the past with what are now out-dated technologies, which are difficult and expensive to conserve and restore.

> However, there is a particular reason why, especially in the case of Web art, serious scholarly research is considerably hampered or impaired—a reason that might also conceivably make becoming a "Net art historian" impossible, and not just for me. This reason is the rapid decay of an art form that in several respects—software, hardware, and the contextual system in which it is embedded and with which it often works—is an art of unstable media.[122]

[121] Shanken, Edward A., "Contemporary Art and New Media: Toward a Hybrid Discourse?", accessed October 11, 2013: https://hybridge.files.wordpress.com/2011/02/hybrid-discourses-overview-4.pdf.
[122] Kuni (2009), 194.

The difficulty in conserving media art works is the topic of an ongoing discussion. The arguments that Verena Kuni puts forward in her article, not only point out the difficulty of conservation, but also the consequences of such difficulties for art historians and their careers. Because of the ephemeral character of media art works and the lack of dedicated archival institutions, many art historians are discouraged from specialising in new media and digital art works. In this respect, the title of the article - "Why I did not become a digital art historian" - written by one of the most respected specialists of digital art and internet art in the German speaking world, is quite surprising but nonetheless understandable.

Another argument, concerning the interactive quality of many media and digital art works, is put forward by curator and historian Christiane Paul. In her opinion, the interactive quality of these works is the reason why, astonishingly, they are ultimately less accessible to the public.

> One of the greatest challenges of curating and presenting new media art to a traditional art audience is to balance the demands of the art and of visitors. Non-interactive and reactive pieces tend to be more "successful" in engaging a museum audience, but easy accessibility does not equal good art.[123]

One might be tempted to consider interactivity as an element that facilitates the dialogue between the audience and the work. It is not the opinion of Christiane Paul, who stresses that the traditional museum audience is rather accustomed to a passive relationship with artworks and is likely discouraged from engaging in works that demand a higher level of interaction. In her opinion, curators and directors of many museums consider it a challenge to present works that demand interactivity, such as media and digital artworks. Because traditional art works tend to be more successful in appealing to a more traditional audience, and because of the imperative of institutions to record a higher number of visitors, Christiane Paul concludes that compared to more traditional works new media and digital art is disadvantaged when it comes to the possibility of being presented in prestigious institutions.

---

[123] Christiane Paul, "Challenges for a Ubiquitous Museum" *New Media in the White Cube and Beyond: Curatorial Models for Digital Art* (Berkeley: University of California Press, 2008), 64.

A last argument that is worth considering is proposed, again, by Edward Shanken, who offers a complex and manifold explanation of the digital divide. The American art historian is also among those who strongly support the reunification of these two fields, condemning the separation of new media and digital art from the traditional field, considering it detrimental for the former. If most of the arguments previously discussed tend to put the blame on the traditional art field, Edward Shanken offers a last argument that partly blames the new media artists and curators.

> Some blame must be placed on the artists themselves, many of whom lack traditional art training and have cultivated little sensitivity to and experience with the materials and techniques of MCA installation and exhibition practices. Critics and historians have not focused enough attention on theorizing across borders. Curators are also culpable. NMA curators must master the conventions of MCA if they are to succeed in exhibiting NMA in that context and must be able to make connections between works made in both fields. By the same token, MCA curators who are unfamiliar with NMA and the technical and spatial considerations that it demands are ill-prepared to create compelling exhibitions. They must also familiarize themselves with the field and be able to recognize and draw conceptual parallels between works that use conventional and new media.[124]

In this argument, Edward Shanken affirms that many artists and curators working within the new media art field ignore the dynamics and the strategies, as well as the language of the traditional art world. This is the reverse of the competence argument, addressed instead this time to the media art field. Because of their lack of competences in the usages and norms that regulate the traditional art world, new media artists and curators are unable to professionally and successfully position themselves in the traditional field. In his opinion, it is not only the duty of the actors of the traditional art world to be more attentive about digital and media art production, but it is also the responsibility of new media artists and critics to be able to understand and enter the traditional field of art.

To summarise, two main arguments appeared in the writings of art historians and critics engaged with new media and digital arts who recognised the separation of this field from the traditional field of contemporary art. The most discussed argument is the lack of commercial interest in media artworks, due to their particular digital or technological

[124] Shanken, Edward A., "Contemporary Art and New Media: Toward a Hybrid Discourse?", accessed October 11, 2013: https://hybridge.files.wordpress.com/2011/02/hybrid-discourses-overview-4.pdf.

nature, the second is the lack of interest and competence among the majority of actors working in the traditional art field towards new media art. Along with these two arguments, other reasons have been offered such as the ephemeral nature of technologies and the resulting difficulty in archiving and documenting them (Kuni), the complexity of the interactive character of media art, discouraging the traditional museum audience (Paul) and the lack of competence among new media artists and curators to position themselves in the traditional art world (Shanken). It is interesting to note that most of these arguments tend to attribute the fault of the digital divide to the contemporary art world, with the exception of one argument by Edward Shanken. Another important point to consider is that, with very few exceptions, the arguments previously discussed implicitly suggest that the digital divide is unfortunate and detrimental to the new media and digital artistic production. Although this statement is not explicitly expressed, the idea that media and digital art suffers from the exclusion from the traditional field of art is constantly elicited in the considerations concerning the exclusion from the market and from the most prestigious exhibitions and events associated with the traditional art field. Is the digital divide a reality? Are the arguments offered by the critics providing an exhaustive explanation of the claimed digital divide? Is it really the case that this separation is detrimental to the media and digital arts? These questions will be reconsidered in the concluding chapter, after the analysis of some specific cases of computer-generated art works and their context of presentation.

For now, it can be concluded that there is not one, but many histories of generative art. If many art historians, critics and artists have been inscribing the activities of artists and their works into a possible narrative, and providing a variety of definitions, it is because there are several common factors in the works of generative art. The concept of emergence is probably the most distinctive and recurring element within this type of artistic production. Because the concept of emergence is a peculiar concept discussed in the sciences, in particular in the fields of artificial intelligence, artificial life and robotic research, artists engaging in generative art have often been compelled to contribute or at least confront some of the philosophical and scientific aspects of emergence. In this sense, computer-generated art has often been regarded as a production that bridges the gap between the humanities and the sciences. But is this description and approach

toward computer-generated art still suitable today? Has the concept of emergence always been the focus of the artists? Have they changed their position, particularly with regard to the scientific research with which their work has been associated? Computer-generated art is a paradigmatic example through which one can investigate the dialogue between artistic production and the scientific research, as has been outlined here. Of particular interest is the position of the artists with regard to the impact of the computing machine within society. Computer-generated art is, furthermore, a suitable lens through which to consider the problematic relationship between the fields of new media art and contemporary art.

Chapter 2

2.1 The Pioneering Period of Computer Art 1968-1983

At the end of the sixties, computing machines were becoming popular not only within scientific research but also in the art world. The foundation of the Computer Arts Society in London in 1968, the exhibitions *Cybernetic Serendipity* at the Institute of Contemporary Arts in London in 1968 and *Software* at the Jewish Museum in New York in 1970, all attest to the growing interest in the use of computers in an artistic context. Catherine Mason describes the sixties and seventies as the pioneering period of British computer art, largely characterized, in her opinion, by the discussion of cybernetic theories, the significant role played by Academia and the lack of mainstream institutional support.[125]

Among the cohort of artists using computers to produce works of art (for the most part exploiting their graphical applications) some tried to experiment more specifically with the opportunities to program the machine. Edward Ihnatowicz and Harold Cohen are two examples of such an approach and are today often cited in publications retracing the history not only of computer art, but also of digital and media art in general. For example, Paul Brown mentions both artists as early examples of generative art,[126] while Eduardo Kac recognises in Edward Inhatowicz, together with Nam June Paik and Tom Shannon, an important pioneer in robotic art.[127] Nonetheless, if Harold Cohen and Edward Ihnatowicz raised curiosity among art critics interested in computer art at their time, many historians affirm today that the significance of their work has been largely neglected by traditional critique. Paul Brown, in his extensive article about early computer art recognises their importance, but remarks that "many of the early pioneers

[125] Catherine Mason, "The Routes toward British Computer Arts: The Role of Cultural Institutions in the Pioneering Period", in *White Heat Cold Logic: British Computer Art 1960-1980*, ed. Paul Brown (Cambridge: MIT Press, 2009).
[126] Paul Brown, "From Systems Art to Artificial Life: Early Generative Art at the Slade School of Fine Art", in *White Heat Cold Logic: British Computer Art 1960-1980*, ed. Paul Brown (Cambridge: MIT Press, 2009).
[127] Eduardo Kac, "Foundation and Development of Robotic Art", *Art Journal*, 56, no. 3 (1997): 60-67.

of the computational arts (including Cohen and Ihnatowicz) were never adequately recognized by the mainstream art world when it became increasingly dominated by the post-modern aesthetic paradigm during the 1980s."[128] Together with several other media art critics today, Brown affirms that artists working with new technologies such as computing machines and robotics were never really credited by the most important museums, art centres and commercial galleries. His remark is an implicit recognition of the digital divide.

Because many historians involved in the field of digital and media art today regard Harold Cohen and Edward Ihnatowicz as seminal reference points for early computer art, an analysis of their works can provide a better understanding of positions toward the computing machine and its associated scientific research during the pioneering years of this kind of artistic production. They both have created works in which the machine plays an essential part and supplemented their artistic research with publications that provided extremely interesting ideas, perspectives and reflections not only on their artistic vision and activities, but also concerning epistemological questions.

In this chapter, I analyse the work *Senster*, created by Edward Ihnatowicz and presented at the Evoluon exhibition centre from 1970 to 1974, and the lifelong project *AARON* by Harold Cohen, in particular the early production from 1971 to 1983. These works are described in their specific context, including the presentation to the public, their reception and the larger cultural context in which the works where produced. More significantly, I have focused on the intention of the artists by analysing their written articles and interviews. What drove Ihnatowicz and Cohen to turn to computing machines to develop their work and research? What was their perspective towards the advancements of the scientific research with which they have been associated? How has their work been received by critics and journalists? As two influential figures within the emergence and subsequent historical narrative that frames computer art, Ihnatowicz and Cohen present a suitable case study from which to draw some key considerations about the early visions, goals and expectations of an artistic production that is still evolving today.

[128] Brown, "From Systems Art to Artificial Life: Early Generative Art at the Slade School of Fine Art", 277.

2.2. Harold Cohen

2.2.1 From Painting to Programming

Before using computing machines and writing codes to generate drawings, Harold Cohen was leading a successful career as a British artist, renowned for his abstract paintings and invited to exhibit in prestigious institutions such as the Tate Gallery in London, the Jewish Museum in New York and the Musée d'Art Contemporain in Montreal. He also represented England at the 33rd Venice Biennale in 1966, together with his brother Bernard Cohen and artists Anthony Caro, Robyn Denny and Richard Smith. Two years later, in 1968, he was invited as a visiting lecturer to the Visual Arts Department at the University of California San Diego, where he was introduced to Jeff Raskin, a student in computer engineering who introduced him to computer language and programming. Cohen put aside his activity as a traditional painter and concentrated on programming, learning basic languages like Ditiran and Fortran. Subsequently, he created a specific computer program capable of independently producing drawings, a program that would become the cornerstone of his future artistic career. This story is well known and is related in many articles and publications on the artist, emphasising the difficult but audacious decision of an emerging, successful painter to give up a promising career in order to dedicate himself to computing machines and programming.[129] Cohen provides some reflections, pointed with sharp criticism, on the traditional activity of painting and its strong association with the art market, in a text published on the occasion of the documenta 6 exhibition in 1977. He affirms that his motivation to abandon painting was also due to the dissatisfaction with the activity itself:

> What appeared clear to me, indeed, was that painting had left my intellectual appetite unfulfilled; a need for clarity and precision remained unsatisfied.[130]

[129] See, for example: Pamela McCorduck, *Aaron's Code: Meta-art, Artificial Intelligence, and the Work of Harold Cohen* (New York: W.H. Freeman, 1991).

[130] "Was tatsächlich klar zu sein schien, war, dass die Malerei meinen intellektuellen Hunger ungestillt liess, ein Bedürfnis nach Präzision und Klarheit unbefriedigt blieb." Harold Cohen, "Harold Cohen", in *documenta 6: 3 (*Kassel: Dierichs, 1977), 262, my translation from the German.

It is not the purpose of this research to recount the life of Harold Cohen. Nevertheless, the fact that this particular moment in his career is often acknowledged by historians and by the artist himself,[131] highlights how the use of computers in an artistic context was perceived as a difficult, audacious and even alienating choice for an artist. To engage with computers was regarded as unconventional, in particular for an artist associated with the traditional activity of painting. The manufacturing of the digital divide seems to have been prepared before the recognition of the new media art field itself.

Cohen's experiments with machines resulted in the creation of *AARON*, a work that can today be considered his most famous and ambitious; a work that he has since continued to develop, modify and improve. However, the question of how to define it as an artwork might pose some problems. *AARON* is a computer program, a series of codes written by the artist to produce a large quantity of drawings through an assemblage of hardware: computers, terminals, printing turtles and plotters. The hardware changed over the decades and the program evolved. Not only did Harold Cohen create a program to challenge the activity of image making, he also wrote many articles in which he described his artistic research, the capacities of *AARON* and his speculations on topics associated with computing machines and artificial intelligence.

Is it really the case that the artist abandoned painting for programming? What were the preoccupations that guided his artistic research with machines? Through the analysis of Cohen's work, in particular during its first years of development, from 1971 to 1983, I will attempt to answer these questions. This period of time corresponds to the first decade of the program, from its first official presentation during a computer conference organized by the Data General Corporation[132] to the publication of *The First Artificial Intelligence Coloring Book* edited by Cohen, his wife Becky Cohen and Penny Nii.[133] This time period comprises three important solo exhibitions, as well: one at the

[131] Harold Cohen, "Driving the Creative Machine" (paper presented at the Orcas Crossroads Lecture Series, Eastsound, September 2010).
[132] Mention of the first presentation of the computer program is in: McCorduck (1991), 37.
[133] Harold Cohen et al., *The First Artificial Intelligence Coloring Book: Art and Computers* (Los Altos, California: W. Kaufmann, 1984).

Stedelijk Museum in Amsterdam in 1977, one at the San Francisco Museum of Modern Art in 1979 and one at the Tate Gallery in London in 1983, in addition to the invitation to participate in the drawing section of the documenta 6 in 1977.

2.2.2 Early Computer Drawings

During the years that followed his visit and residency in San Diego, Cohen produced works that relied on the use of computers, together with more traditional hand-made drawings. The Victoria and Albert Museum in London host in their archives one of the most extensive collections of printed works by Harold Cohen accessible to the public, in particular the program's early productions. It is interesting to consider some of the hand drawings, within the collection, made by the artist during the same years in which he started experimenting with computers. The pencil drawing Untitled E.335-2009, 1971, and the screen print Untitled E.318-2009, 1971 (Figure 1), represent the development of his previous artistic approach, characterized by abstract compositions. These works depict organised shapes on the surface, delicately drawn by hand, mostly with long, single traits. They are also organised and connected together, as if to depict structures that could be found in the natural world. The shapes - often circular, irregular and almost organic - are representative of a characteristic hand-made drawing and are easily recognised as being made by a human author. If we compare these works with the first documented work within the collection generated with a computer by the artist, the similarities with the hand-made drawings are striking. Untitled E.316-2009, 1971, and Untitled E.321-2009, 1972, consists of computer-generated drawings with words encircled by irregular traits or fields. Harold Cohen seems to have continued his formal research developed in his drawings and paintings with the use of the computer. But the work within the collection that mostly presents an autonomous functioning of the program and constitutes the starting point to the subsequent development, is Untitled E.325-2009, 1971 (Figure 2), which consists of a computer generated drawing depicting a cluster of lines, some of which are connected to one another. In this work, exclusively created by the machine, the artist approached the fundamental problem of organizing lines within the space delimited by the surface of the paper. On closer inspection, it

appears that the lines are composed of several dots produced by a plotter. The forms created by the computer in this drawing present many analogies to the precedent hand-made drawings of the artist. A more elaborate composition, formed by a series of increasingly complex structures, appears in Untitled E.341-2009, 1972 (Figure 3), in which the lines are organized in distinct groups, similar to grapevines, folding on each other to depict something that looks very similar to a solid shape.

The work Untitled E.342-2009, 1974 (Figure 4), describes a considerable progression in the computer program's ability to generate a greater variety of forms. The lines are not simply connected to each other in some nodal points: they are organised together to produce closed, circular figures. Not only does the program produce irregular, organic-like forms, it also distributes them in relation to one another, creating more elaborate structures. For example, the association of a circle with a smaller one generates an image that could represent a very simple organic, three-dimensional shape, such as a cell or a rock. The work Untitled E.326-2009, 1974, is very similar, although in this specific case, the artist has coloured by hand the computer-generated drawing. Instead of transforming the abstract organic-like shapes into recognisable forms, the artist has simply highlighted the forms produced by the computer program, filling the spaces with different colours. It is clear that the colouring activity of the artist is not intended to modify the work of the computer, nor is the work of the computer a simple background upon which the artist freely creates a new painting. The purpose of the colouring is really to emphasise the forms generated by the program, something that Cohen did manually until he managed to write a program capable of autonomously handling colours.

A particularly interesting series of prints, in the V&A collection, is the *Amsterdam Suite*, created in 1977 for the artist's personal exhibition at the Stedelijk Museum (Figures 5-8). It is a series of lithographs in an edition of 75, produced from a computer-generated drawing. The series comprises six different prints, plus a version of the first print with colouring added by the artist. The *Amsterdam Suite* presents a further development of computer-generated images, with a wider variety of shapes, figures and motifs. The drawings are still abstract, and most of their elements are very simple - a

zigzag, a group of crossed lines, a reticule - but some other elements seem to suggest allusions to physical objects: for example a flower, a rock, a bird, a tree, an eye, or the horizon line. The series demonstrates that the program is capable of generating a variety of patterns that could be organised in more complex compositions.

The early drawings produced by Cohen with his computer program are clearly a further development of his previous research, as a painter. With the computing machine, the artist investigates the production of forms, the organisation of space and the basic elements that constitute the representation of images of greater complexity. On the other hand, these early drawings are the premises for the further development of the works produced by *AARON*. If we consider the later works in the V&A collection, such as Untitled E.343-2009, 1985 (Figure 9), and the more elaborate one Untitled E.337:1-2009, 1987 (Figure 10), in which the program attempts to reproduce recognisable figures, humanoid or animal-like, in a realistic landscape made of rocks and trees, the building-blocks that were previously developed by the program are still recognisable. Quite significantly, the signature of *AARON* appears next to the signature of the artist, in some of these works, a signature that is clearly generated by the program, while the signature of the artist is hand-written. It is important to stress that, prior to these figurative works, Harold Cohen did not instruct the machine to create recognisable figures, that is to say: he did not supply the computer with pre-determined forms. The artist made clear that the machine did not have any information about the world whatsoever. If figures and shapes are recognisable to the viewers in the early drawings, this was not the purpose of the artist. However, the fact that figures and shapes might be recognised in a drawing generated by a machine that does not have any empiric knowledge of the objects it creates, is considered by the artist as an interesting way to investigate the possibility of creating an image that can carry a symbolic representation. These ideas are developed in his essay, "What is an image?", published in 1979.[134]

The analysis of these early drawings suggests that with a computer program, Harold Cohen tried to create works that are similar, from a formal point of view, to drawings

[134] Harold Cohen, "What is an Image*?", IJCAI-79: proceedings of the Sixth International Joint Conference on Artificial Intelligence, Tokyo, August 20-23, 1979* (Los Altos, California: Distributed by William Kaufmann, Inc, 1979), 1028-1057.

made by human beings, reproducing organic-like shapes. This is a different approach which, compared to the one generally associated with early computer graphics and art, often exploits the intrinsic aesthetic of the machine to generate drawings that present rigorous geometric patterns. Furthermore, this aspect suggests that Cohen is really trying to investigate, through his program, the functioning of the human activity of drawing, a research that could be considered as an epistemologically driven one.

On several occasions, Cohen expressed that he does not consider his program as being creative, although he does not regard it as being a tool, either.[135] It is therefore interesting to examine the definitions of *AARON* proposed by the artist. Simply put, *AARON* is a computer program hosted in a computing machine that generates drawings through a printing device. Many definitions can be found in the artist's essays.

> *AARON* is a knowledge-based program, in which knowledge of image making is represented in rule form. (...) It is a complete and functionally independent entity, capable of generating autonomously an endless succession of different drawings.[136]

> *AARON* was not GIVEN all these rules and instructions. *AARON* WAS the rules and instructions. Adding new rules to the program was not changing what *AARON* HAD, it was changing what *AARON* WAS, its very structure.[137]

A knowledge-based program, a set of rules and instructions, an independent entity, these are some of the possible ways that the artist has described and defined his work. Cohen affirmed that, although some of *AARON*'s knowledge could be considered declarative and that it doesn't behave randomly, it is also not producing paintings that are pre-programmed as such by the author of the code. At first look, there is no actual reason not to consider *AARON* to be really creative, if by creativity one simply defines the activity of producing a drawing or a painting. Nonetheless, as the artist affirms, the word 'creative' tends to be employed to describe a more noble activity, one that only human beings are entitled to engage in. Such is the case when the word is used to describe, for example, a talented and inventive person. Because of the lack of objective criteria that allows for the attribution of this particular use of the word 'creative' to a

[135] Harold Cohen, "How to make a drawing", (paper presented at the Science Colloquium, National Bureau of Standards, Washington DC, December 17, 1982), 5.
[136] Cohen (1979), 1030.
[137] Cohen (1982), 4.

person, and even more to a program or a machine, Harold Cohen judged it inadequate to use the term when referring to his own work, although he concedes that it does, to some extent, display creative features. In a later article, he admitted his difficulty in dealing with the term 'creativity' and affirmed that he eventually preferred to avoid it.[138]

Considering the particular nature of *AARON*, the artist made clear that he did not intend it to be used as a tool, at least not in the sense of an instrument to be employed by the user. *AARON*, in fact, permits no interactivity. This is possibly the most important reason as to why Cohen has always distanced himself from the cluster of artists associated to computer art, a label that was often attributed, during the seventies, to artists and graphic designers using computers as a creative tool to produce works and images. For Cohen, computer programming was not an instrument to facilitate and automatize the production of paintings. Rather, for Cohen programming was intended to be a work in its own right.

The decision to work with a machine inevitably raised several questions: not least, the commonly debated question of originality and authenticity. Who is the author of the paintings generated by *AARON*, the computer or the man behind the program? Is the program itself a work of art or are only its drawings and paintings? Is *AARON* to be considered a unique work in progress, together with all its productions of drawings and paintings, or is every single version of *AARON* a distinct work of art? The artist donated several paintings produced by *AARON*, together with photographs taken of the machine and, quite significantly, some original pieces of hardware, such as cables, turtles, plotters and other physical devices to the Computer History Museum, in Mountain View, California. All of these elements are catalogued by the museum with a number, a description and a picture and have been stored and labelled for historical and conservational needs. About 20 physical objects are registered in the archive. Here are some examples of the descriptions that are listed in the website collection of the museum: '*AARON* Paint System assorted ribbon cables, physical object', '*AARON* Paint System vessel, physical object', '*AARON* Paint System regulator, physical object',

[138] Harold Cohen, "Colouring Without Seeing: a Problem in Machine Creativity", in *AISB quarterly*, no. 102 (1999).

'*AARON* Paint System power chord, physical object'.[139] The descriptions and references employed by the museum are effective in providing a useful system of archiving within the context of the collection, but they certainly wouldn't be effective in giving a more comprehensible definition of *AARON* as a work of art. After all, the work has been constantly updated and embodied in varied and different machines through the years. It also went through different stages and has been constantly modified. In several articles, Cohen explicitly stated that *AARON* is the program, not the hardware hosting it. During the solo exhibition at the Tate Gallery, for example, the artist presented the work in the exhibition space as a functioning installation, displaying the computing machines, the terminal and the turtle drawing the shapes on the paper laid on the ground. The images of the installation are found in the catalogue, which also presents the description and the diagram of the whole system. Nevertheless, Cohen was ultimately dissatisfied with this mode of presentation, as he admits in the text of the catalogue, and he felt obliged to remove the turtle from the exhibition space because the public was more interested in its movement, rather than appreciating the drawings.[140]

If it is clear that *AARON* is the computer program, and not the machine, it is however more difficult to present and record the work as such in a museum space. What is more, the fact that *AARON* produces physical drawings that are suitable to be exhibited, collected and archived, presents an ideal opportunity for institutions interested in acquiring the work of the artist for their collections. If the Computer History Museum, in Mountain View, California, decided to archive the physical elements and hardware, something that is pertinent to the nature of the museum which focuses on computer history, the Victoria and Albert Museum's decision to acquire only those *AARON* drawing that were printed on paper is understandable. However, of the three important museums that hosted a solo exhibition of Cohen during the considered time frame - the Stedelijk Museum, the Tate Gallery and the San Francisco Museum - only the Tate Gallery and the Stedelijk Museum display works from Harold Cohen in their collection. The Stedelijk Museum holds only one work from 1978, while the Tate collection holds a list of fifty-three Cohen works. Fifty of these pre-date works made by the artist before

[139] Computer History Museum, accessed June 17, 2014: http://www.computerhistory.org/collections.
[140] Harold Cohen, "Introduction", in *Harold Cohen: The Tate Gallery [8 June - 24 July 1983]* (Millbank, London: Tate Gallery, 1983), 8.

the creation of his computer program. Two works are early computer generated works by Harold Cohen made in 1971 and 1972, and only one is a work created by the program *AARON*. This unique work by *AARON* in the collection of the Tate Gallery is a donation to Michel Compton, who was responsible for the artist's exhibition in 1983. His name is mentioned on the work with a dedication note.[141]

The analysis of the early production of *AARON* reveals that Cohen was interested mostly in the question of the genesis of forms. The comparison of his hand drawings of the late sixties and early seventies to the first computer drawings, shows that Cohen is interested in developing his aesthetic and epistemological research, more precisely on the syntax of image making, research that he started with his artistic career as a painter. The use of computing machines and programming was indeed coupled with further investigations on creativity, symbolic representation and the difference between machines and human beings. What exactly were the artist's preoccupations and, more particularly, how did the artist position himself within the context of the use of computers in an artistic field? The following chapter analyses the articles in which Cohen seeks to understand his personal perspective regarding these questions.

[141] Tate Collection, accessed July 8, 2014, http://www.tate.org.uk/art/artists/harold-cohen-925.

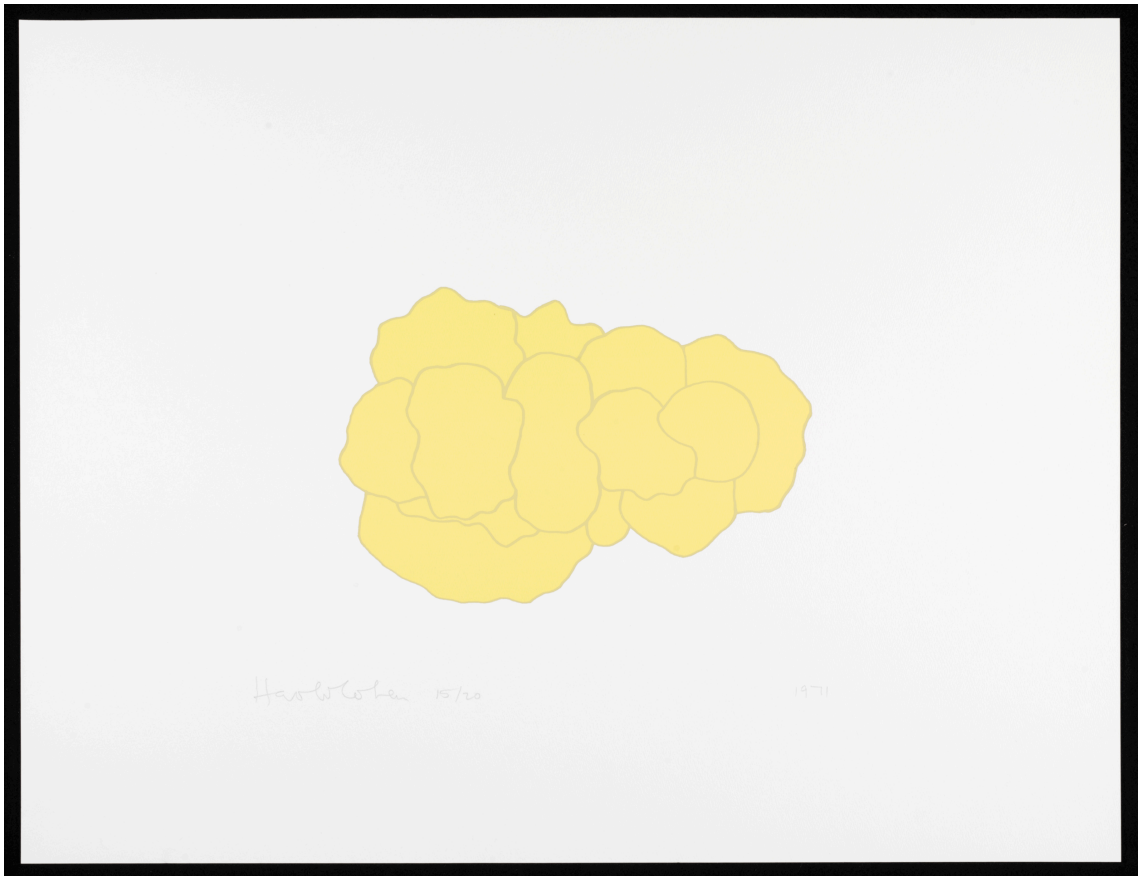

Figure 1 Screenprint, edition 15/20, E.318-2009, by Harold Cohen, 1971.

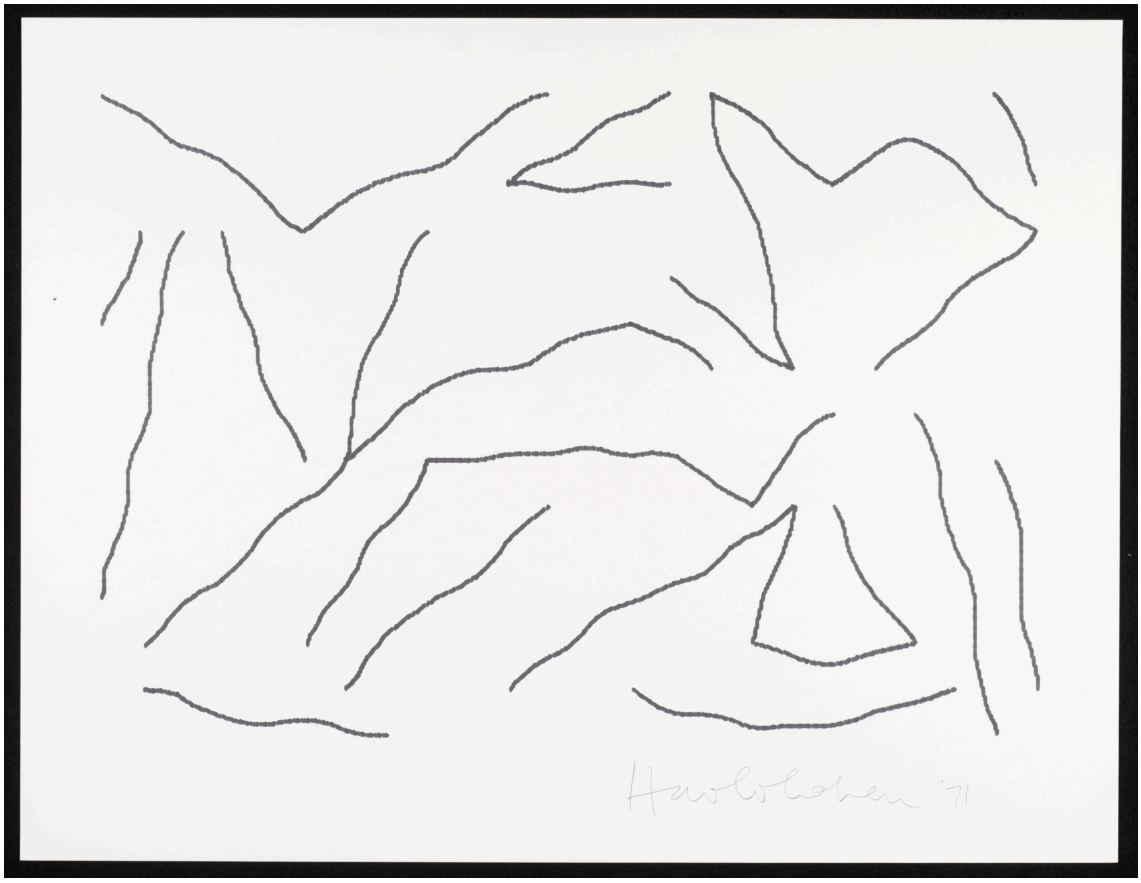

Figure 2 Drawing, computer-generated, on paper, E.325-2009, by Harold Cohen, 1971.
© Victoria and Albert Museum, London/ Harold Cohen. Used with permission.

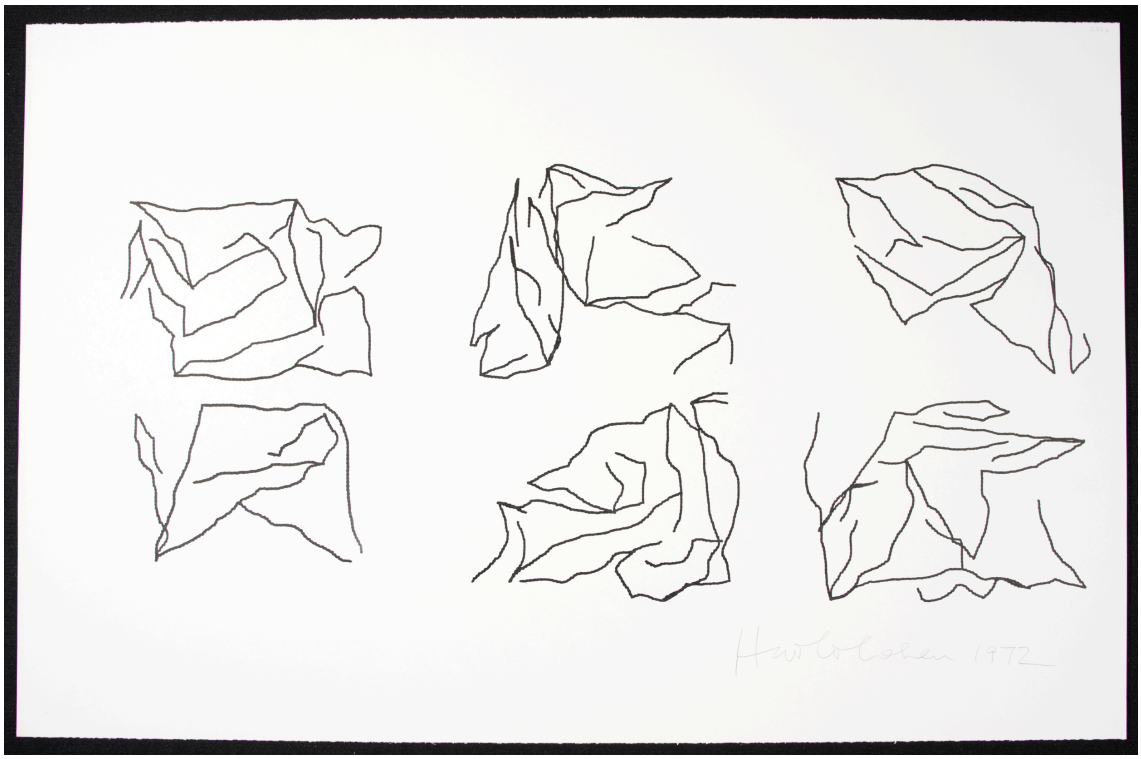

Figure 3 Drawing, computer-generated, on paper, E.341-2009, by Harold Cohen, 1972.
© Victoria and Albert Museum, London/ Harold Cohen. Used with permission.

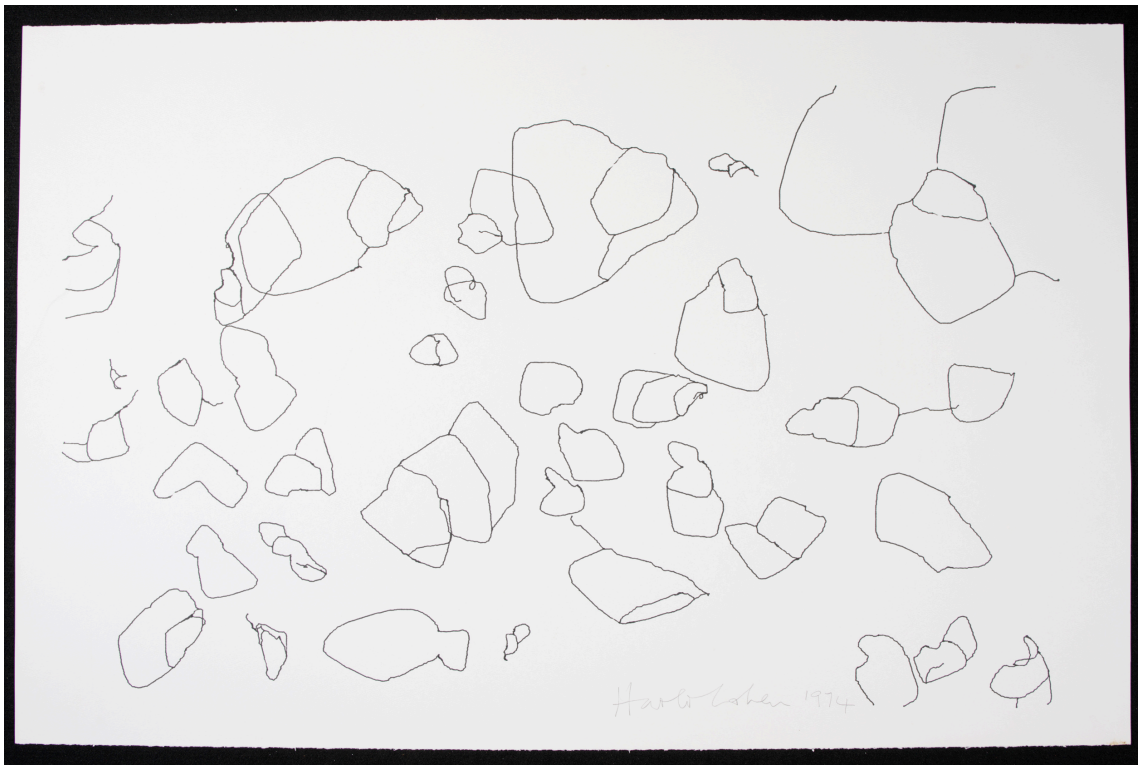

Figure 4 Drawing, computer-generated, E.342-2009, by Harold Cohen, 1974.

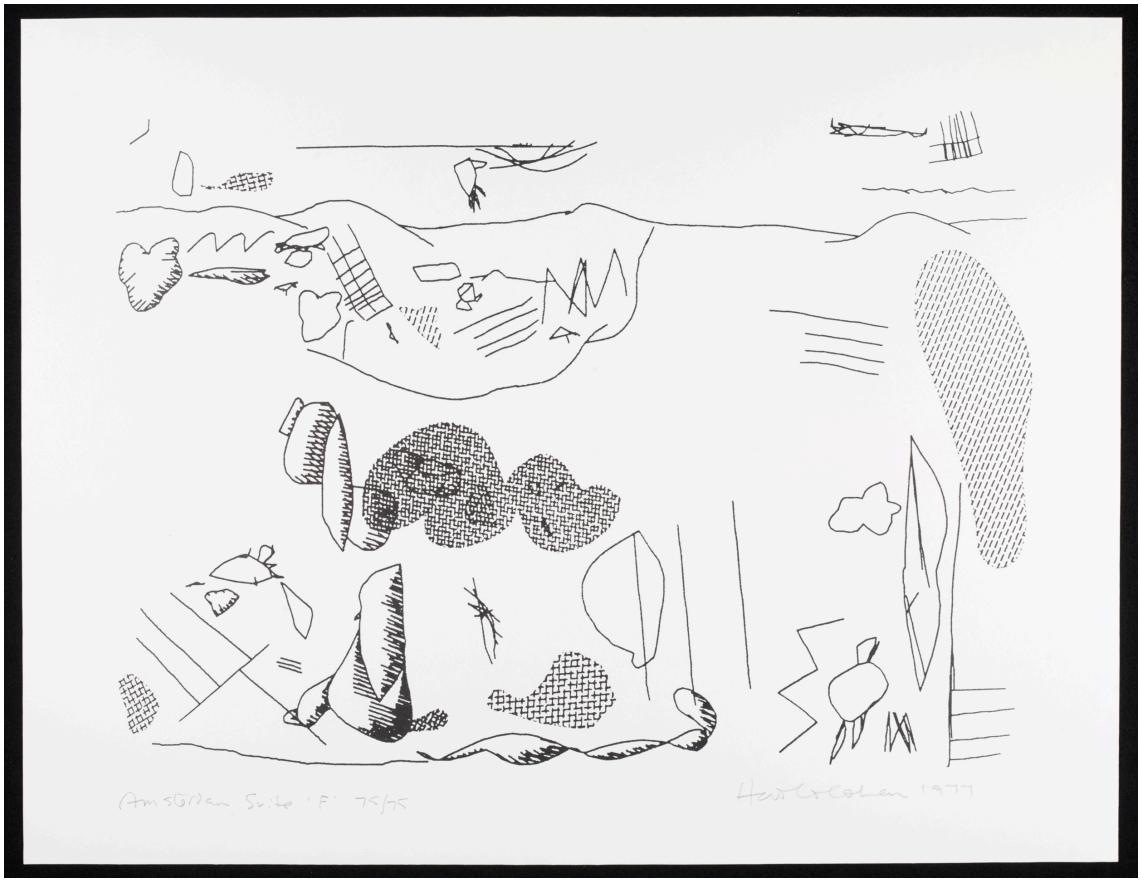

Figure 5 Lithograph, 'Amsterdam Suite F', edition 75/75, by Harold Cohen, 1977.
© Victoria and Albert Museum, London/ Harold Cohen. Used with permission.

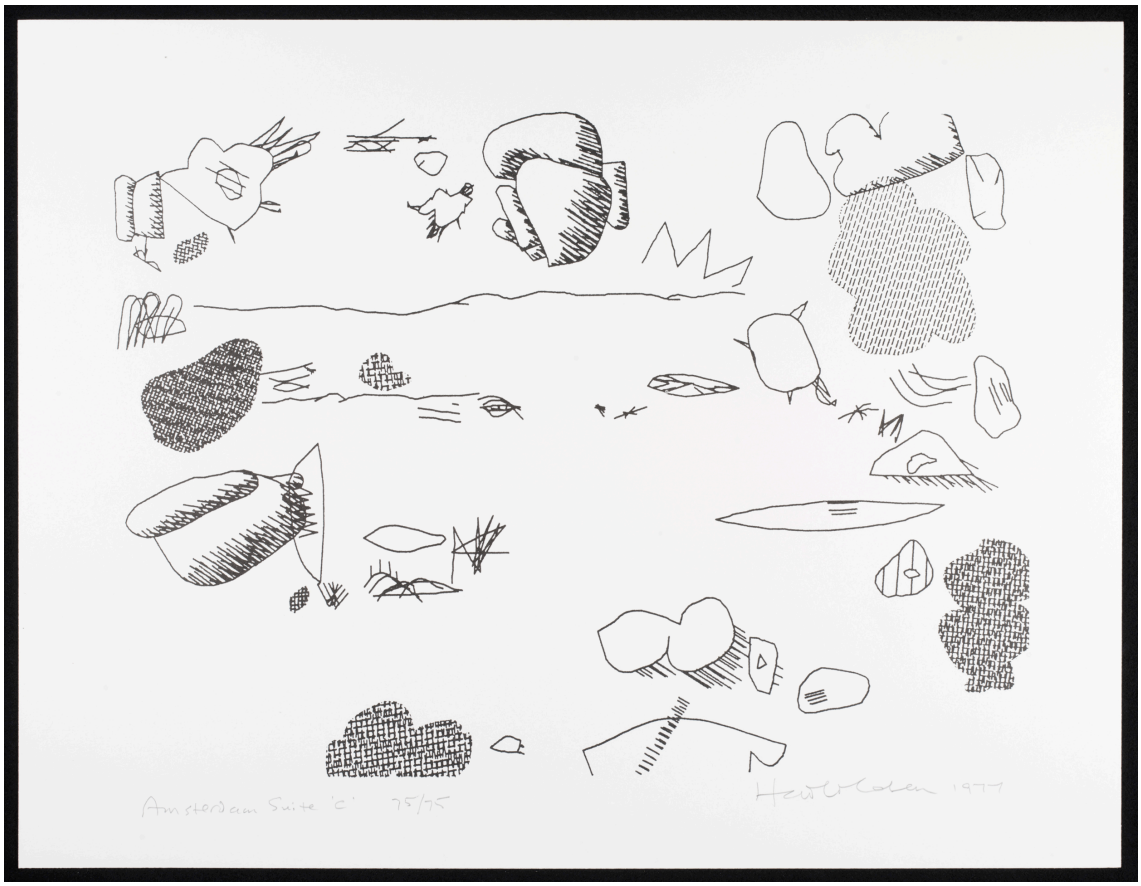

Figure 6 Lithograph, 'Amsterdam Suite C', edition 75/75, by Harold Cohen, 1977.

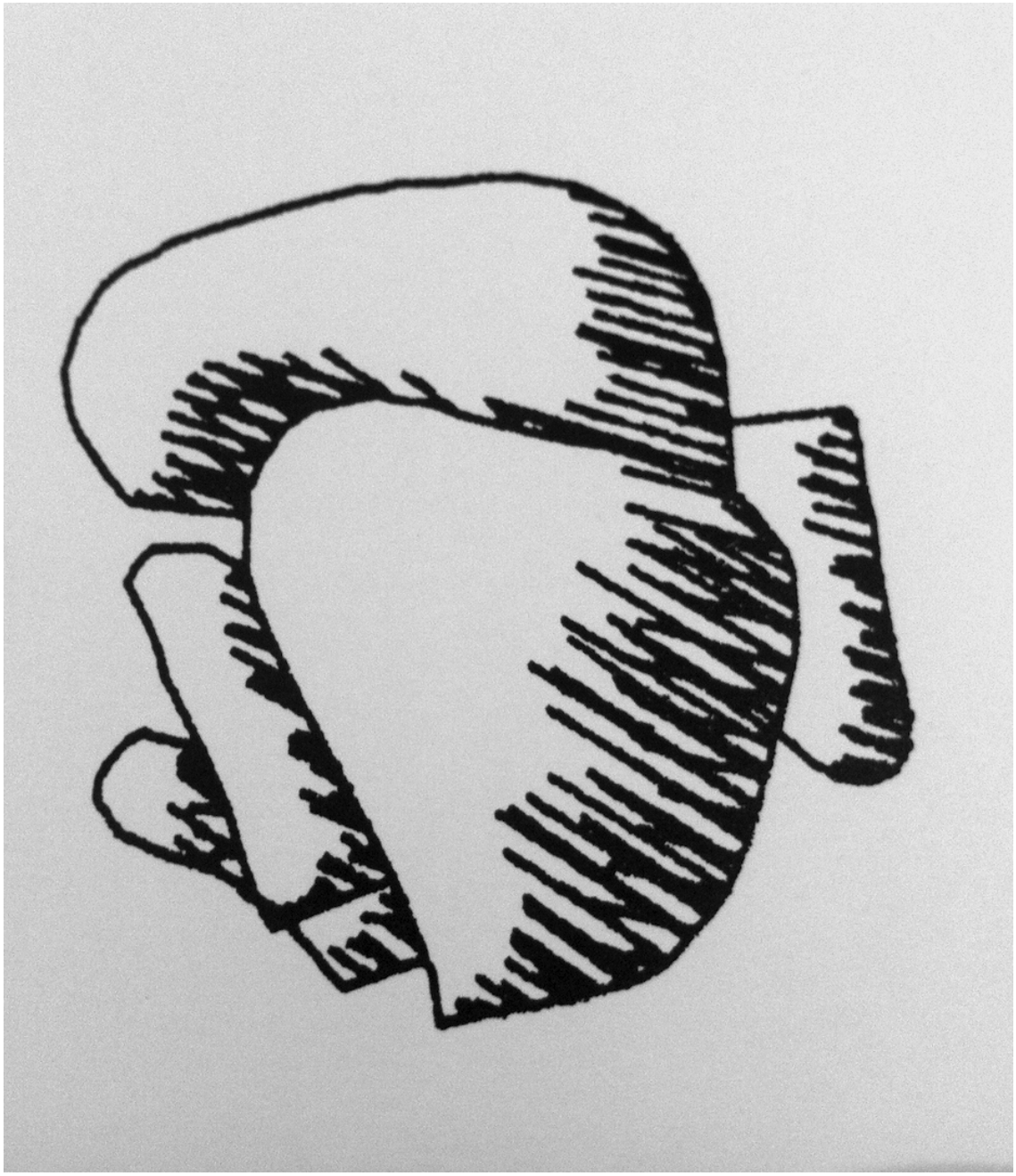

Figure 7 'Amsterdam Suite C', edition 75/75, by Harold Cohen, 1977. Detail.

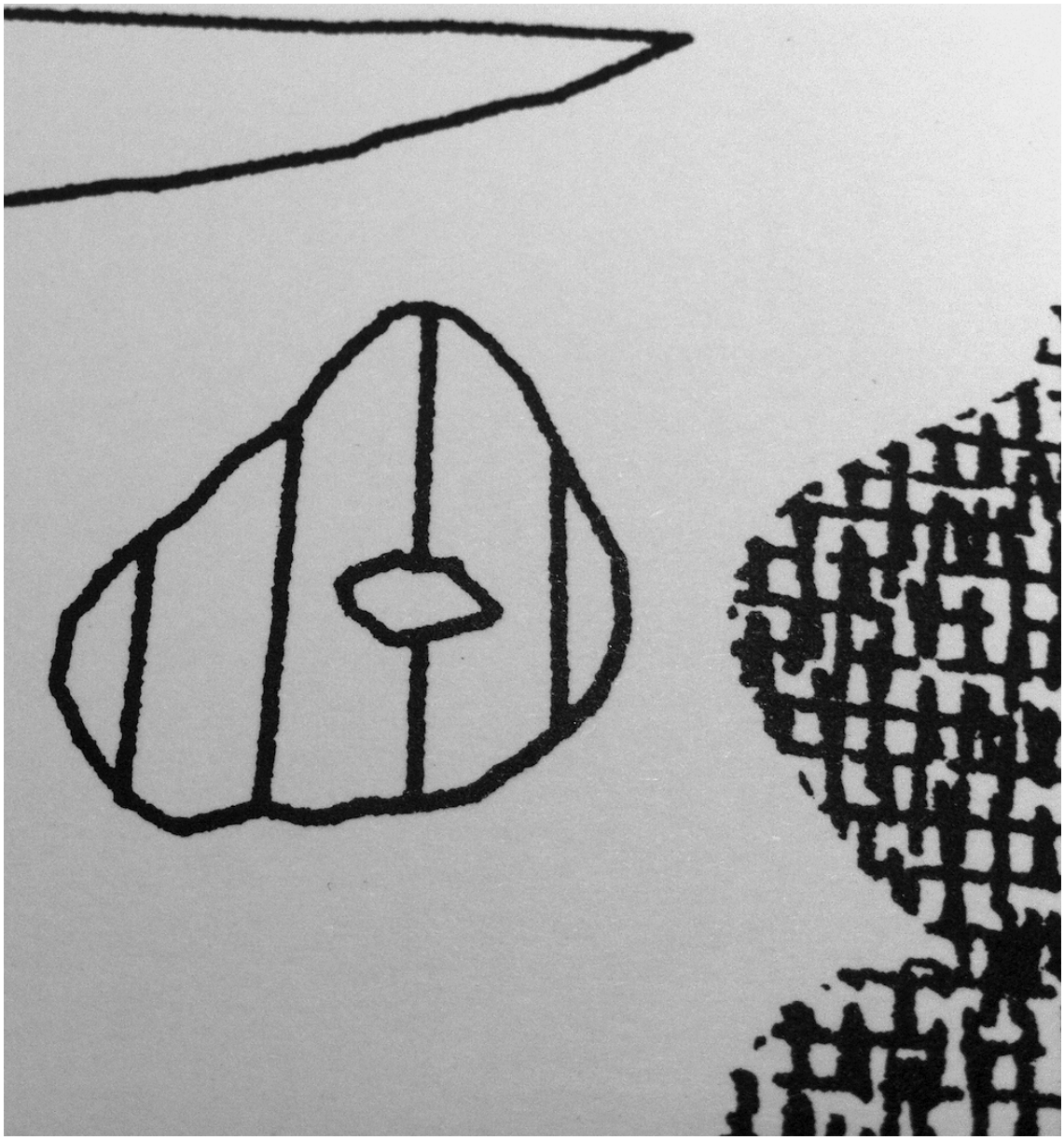

Figure 8 'Amsterdam Suite C', edition 75/75, by Harold Cohen, 1977. Detail.

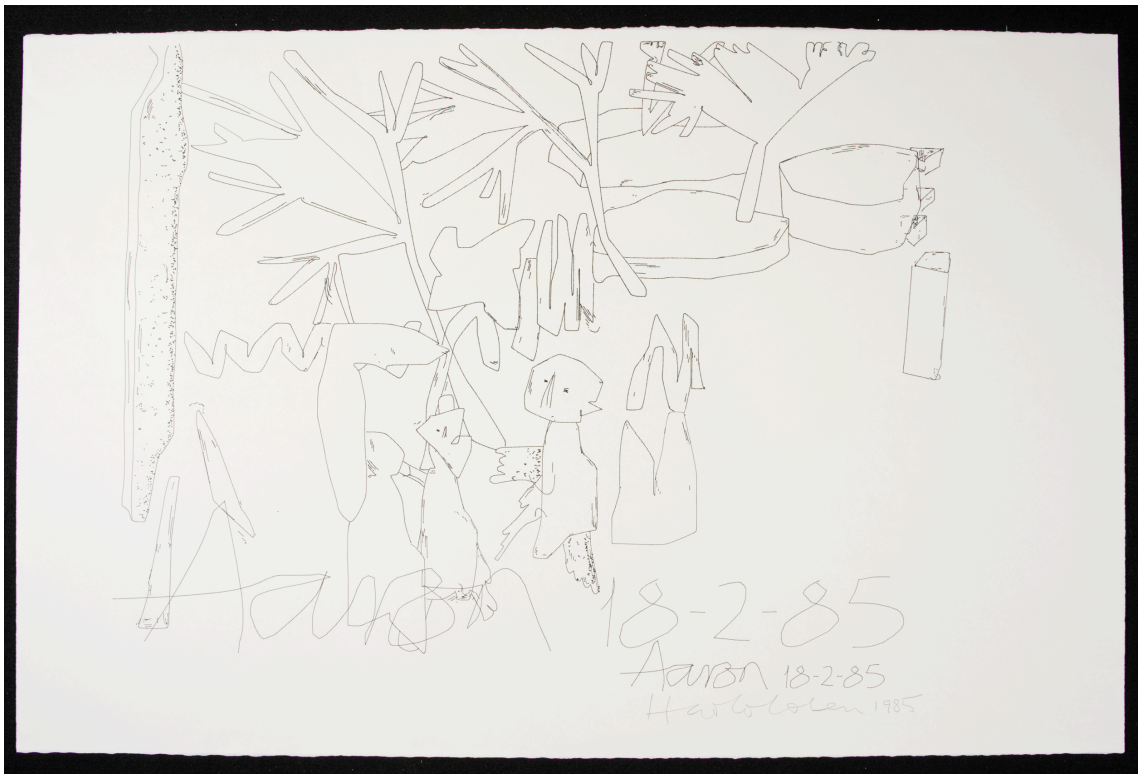

Figure 9 Drawing, computer-generated, E.343-2009, by Harold Cohen, 1985.

Figure 10 Drawing, computer-generated (with drawing on the reverse), E.337:1-2009, by Harold Cohen, 1987. © Victoria and Albert Museum, London/ Harold Cohen. Used with permission.

2.2.3 Creativity, Intelligence and Computer Science

The use of a computing machine marked a turning point in Cohen's research, although he did not use the computer as a graphical tool, nor did he intend to challenge the concept of art and originality. As exemplified by his works produced in the seventies, Cohen researched the act of drawing in greater detail and therefore further developed his previous artistic explorations. His use of programming languages was a means by which to enquire the question of creativity through a machine. In the Tate catalogue published on the occasion of his exhibition in 1983, the artist expresses his motivations:

> I have always had a profound preoccupation with how things work, however, and since the most remarkable 'thing' I know about is the human mind, it is perhaps unsurprising that I saw the program's decision-making abilities as an analogue for human intellectual activity. That I found fascinating, and I still do. I discovered eventually that I was not alone in my attitude, though my co-believers were not in the art world. Under the guidance of Professor Ed Feigenbaum, of Stanford University, I learned how the Artificial Intelligence community went about its business and started again, with more knowledge and more direction than I had had at the beginning, to write programs which would, in some important respects, do what human artists do when they make images.[142]

This passage informs us that Cohen was moved by the urge to understand the functioning of the human mind. Additionally, the artist draws a clear parallel with the artificial intelligence research and highlights how the encounter with Professor Edward Feigenbaum facilitated his understanding of programming. He also communicates his purpose: to make programs that simulate the behaviours of humans as they engage in creative activities such as drawing. This passage alone would suggest that the artist was quite in concordance with artificial intelligence research, something that he would disregard in later articles.

Over a ten year period from 1973 to 1983, Harold Cohen published six papers which are of relevance to this thesis. In these articles, he explains and describes the functioning of the program and his work. He also elaborates on ideas concerning creative behaviours

[142] Harold Cohen, "Introduction" (1983), 7.

and the similarities and differences between a hand-made drawing and a computer-generated one. In addition, he tackles questions related to consciousness, intentionality and artificial intelligence. Through the analysis of these articles, it is possible to understand Cohen's ideas and concerns as he developed *AARON* during the early years.

The similarities and differences between human beings and machines are already approached in "Parallel to Perception", published in 1973, in which Cohen considers more specifically the question of feedback and non-deterministic behaviours in a machine. In the introductory paragraphs, he clearly expresses his ambitious goal:

> If the whole system can autonomously generate art — autonomously, that is, in the obviously qualified sense used above — then we will know something more about ways in which art may be made, and conceivably something about the way in which human beings make it.[143]

Here again, the artist stresses how his intention is to understand the human activity of drawing through experimentation with a machine. In the paper, the question of whether a machine is capable of non-deterministic behaviour appears as a central one. Cohen admits that such question is difficult to solve and that any answer would in turn be dependant on the very idea of human behaviour and machine behaviour.

> But we should examine the implications behind this answer with some care, since it appears to involve the question of whether a machine might be capable of non-deterministic behaviour. I have some doubt whether any definitive answer can be given to this question: whatever more rigorous definitions of the term 'nondeterministic' might be available in other disciplines, it seems to me that here it relates to what we think human behaviour is like at least as much as it does to what we think machine behaviour is like.[144]

Eventually, Cohen resolves to consider that humans and machines don't work within the same environment, thus any attempt to compare and evaluate the two on the same basis is, in Cohen's opinion, erroneous and misleading. According to the artist, a machine must be understood in its own language and terms. On the other hand, in Cohen's opinion, the programmer cannot but relate to his human knowledge and experience while programming a machine, most particularly when attempting to accomplish an activity that has been considered only possible for intelligent beings,

[143] Harold Cohen, "Parallel to Perception: Some Notes on the Problem of Machine-Generated Art", in *Computer studies in the humanities and verbal behavior* IV, no. 1 (The Hague: Mouton, 1973), 125.
[144] Cohen (1973), 128.

such as drawing and painting. This seems to be particularly true, according to the artist, when dealing with questions of images and colours. Nevertheless, the artist does not believe that a machine need to be embodied in a physical environment in order to deal with image-making and being able to produce objects in the physical world, objects that can challenge our ideas about art and creativity. For this reason, he concludes that the conception of a machine imitating a creative activity such as drawing does not necessitate the reproduction of peculiar human abilities such as perception.

Cohen's considerations are further developed in a successive paper, "On purpose", published in 1974. In this article, the artist carefully and precisely explains the functioning of a computing machine. Because the computer is a general-purpose symbol-manipulating machine, as the artist concedes, it is capable of "dealing with any problem which can be given a symbolic representation".[145] He starts with the hypothesis that "machine behavior shares some very fundamental characteristics with what we normally regard as art-making behaviour."[146] A difference between a human being and a machine proposed by Cohen is that the machine cannot draw at random, contrary to popular belief. Human sometimes rely on random acts to take decisions, such as throwing a dice on a table or a sponge on a canvas to create unpredictable patterns, while a machine will always follow an order. Omit this difference and what interests the artist the most are the similarities: a fundamental similarity between the functioning of a machine and the one of a human being is, according to his opinion, the ability to compare things, and to proceed by inferring from the results of the comparison. This process corresponds to a decision-making one. Consequently, Cohen suggests that machines have the potential to couple this decision-making process with the ability to weight the results and modify the parameters that allow the program to make the decisions. To illustrate this capacity of the machine, the artist mentions the early research in artificial intelligence, in particular he cites the checkers program developed by Arthur Samuel which beat a state champion human player in 1962 as an example of a program capable of adapting to the analysis of the outcomes.[147]

---

[145] Harold Cohen, "On purpose. An enquiry into the possible roles of the computer in art", *Studio International* 187, no. 962 (1974): 10.

[146] Ibid.

[147] For an historical recite of the program developed by Arthur Samuel and its exploit, see: Daniel Crevier, *Ai: The Tumultuous History of the Search for Artificial Intelligence* (New York, NY: Basic

In "The material of symbols", an article published at the University of California in San Diego in 1976, the artist deepens his analysis regarding the difference between a human and a machine in the context of image-making. He further investigates concepts of creativity, protocol and feedback. Here again, the artist clearly affirms his purpose:

> The point of the strategy — the building of a computer program — was not to see whether the presence of these behavioral primitives would add a sense of authenticity to the output. It was to see whether the program could generate image-rich material in a controlled context where it would be clear that the effect was not the result of something else.[148]

What is particularly interesting in this article is that, to support his observations, Cohen examines and describes the behaviours of real human beings when they draw. He starts to examine the sketches of his two daughters, in particular when questioned to draw on a piece of paper to which he previously added some random dots. He repeats the same exercise with his art students, some of them being older and having many years of experience. He also analyses the reasoning of his daughters and his students to try to understand if they followed any rules when deciding whether to connect the dots on the paper, or not. Cohen concluded that all the people involved in the experiment were acting in accordance with a limited set of recurring rules. According to the artist, these rules could be summarised with the following observations:

> 1. see if you can see an image in the dots, and if so draw a line around it: 2. if you can't see an image, draw closed figures anyway: and, 3. if you can't do 1 or 2, fake it. "Faking it", on questioning, turned out to mean using open structures like short straight lines, zigzags, and so on, as space filling.[149]

Through these examples, the artist wishes to demystify the idea that image making, as a particular example of art making, involves a peculiar artistic inspiration. The recurring idea of the artistic genius, the inspiration of the muse, are strong metaphors that impregnate both artistic production and its reception, according to Cohen, who nevertheless does not negate a priori the possibility of such occurrences. However, he asserts that the activity of making art, and quite particularly the one involved with

---

Books, 1992), 220-222.

[148] Harold Cohen, "The Material of Symbols", *New Wilderness Letter* 1, no. 1 (1977): 9.

[149] Cohen (1977), 21.

drawing, relies for the most part on processes that do not necessitate these metaphors to be explained.

> What seemed certain to me, and still does, is that freehand drawing involves an elaborate feedback mechanism, a continuous matching of current state against desired end state and a continuous correction of deviation, essentially like the mechanisms we use to thread a needle, or drink a glass of water, or drive a car.[150]

It is interesting to observe how the artist refers to the concept of feedback as an explanation of the necessary process in the activity of drawing. Feedback is a central concept in cybernetics, fundamental to the research of Norbert Wiener, whose work has greatly influenced research in computer science and robotics. The artist uses this concept to partly explain the functioning of drawing, as many other human activities, and thus to bridge the distance between men and machines. The intent to demystify and to better understand the activity of producing works of art is again stated as a motivation of his own work and research with computer-generated images in an article published for the University of California at San Diego, "What is an image?":

> The motivation for this work has been the desire to understand more about the nature of art-making processes than the making of art itself allows.[151]

The article develops a precise description of the functioning of his computer program. As the artist explains, *AARON* is based on a hierarchical system organised by a group of protocols that mostly relies on the 'if-then' series of command, a rather basic feature of programming languages for decision-making. In this article, Cohen admits that his knowledge of the activity of drawing relies on a long artistic career, something that has certainly influenced his approach to experimenting with computers. The artist stresses once more that the machine was never instructed to reproduce a particular drawing, nor was it fed with a specific drawing made by the artist as a starting point. The program does not rely on any kind of input or data to produce drawings: the creation of the drawing by the machine is the result of a process of choices, in which the 'if-then' command plays an important part. This is particularly true for the first years of production; later versions of *AARON* possess a knowledge base to create more complex

---

[150] Cohen (1977), 16.

[151] Harold Cohen, "What is an Image?", *IJCAI-79: proceedings of the Sixth International Joint Conference on Artificial Intelligence, Tokyo, August 20-23, 1979* (Los Altos, California: Distributed by William Kaufmann, Inc, 1979), 1028.

and articulated figures such as animals and people. During its first decade of existence, *AARON* produced his drawings through a series of rules structured to generate points, lines and figures and by organizing these elements in the available space, coupled with a monitoring process. In writing the program with such a hierarchical structure, Harold Cohen was trying to individuate a set of fundamental cognitive processes that are essential to creating images, as well as to understanding them:

> In short, my tentative hypothesis in starting work on *AARON* was that all image-making and all image-reading is mediated by cognitive processes of a rather low-level kind, presumably processes by means of which we are able to cope also with the real world.[152]

To reproduce these cognitive processes in a machine, he chose to focus on three specific ones to start with: the capacity to distinguish between figures and ground, between open and closed forms, and between interiors and exteriors. Although Cohen made it clear that he regarded the functioning of a machine as different form the functioning of the human mind, he proposed to consider the mind as "devoted primarily to establishing symbolic relationships."[153] In the conclusion of the article, the artist mentions that his ideas concerning the nature of visual representation are different from those proposed by the artificial intelligence and cognitive science community. Nevertheless, he concedes that some parallel can be drawn.

Cohen's analysis of creative behaviour, supplemented by his considerations concerning the approach of artificial intelligence research on this subject, are presented in a longer article written during the artist's residency at the Rand Corporation in 1981. In this paper, the artist describes the results of the development of a newer program, *ANIMS*, written with the purpose of investigating the representation of figurative forms such as animals. The program is provided with knowledge of animals from a structural point of view: for example, it has a set of instructions concerning the articulation of limbs. Cohen, describes the new program as being the successor of his previous one, *AARON*, and briefly provides an evaluation of the results achieved with the older program:

> It has shown itself capable of generating extremely diverse, even bizarre, output; yet it is not capable of the purposeful self-modification that

[152] Ibid., 1040.
[153] Ibid., 1047.

> characterizes creativity. It has become apparent that the programming structures it employs will not lead to that end.[154]

In this article, published after ten years of works, the artist draws the first conclusions concerning the results of his research. He admits, for the first time, not to be completely satisfied with his program, in particular because it cannot modify itself autonomously. This assertion suggests that the artist is aiming at devising a truly creative machine. In the conclusion of the article, Cohen elaborates on some suggestions for the conception of a program that could reproduce a more efficient creative behaviour. He names the hypothetical program *AARON 2*, and he describes the features that the program would have to fulfil in order to be considered creative. The features are the following: the program should generate an unpredictable output, and exhibit an adaptive behaviour; it should "generate representational objects which are compellingly 'visual'" and "produce persuasive evidence of the possibility of addressing computer programs to a range of tasks which, like creativity itself, now appears to be fundamentally beyond their scope."[155] These particular features are the result of considerations developed throughout the paper, concerning creativity, representation, image making, but also cognitive functions, consciousness and reflections on the results of artificial intelligence research. Cohen concludes that if one thinks that creativity only belongs to humans, one will never concede that *AARON 2* will ever be creative. However, at the time of the publishing, the artist does not seem to exclude the possibility that creativity could in the future be attributed to machines in general and to his program in particular.

Speculations about the possible development of *AARON 2* are again examined in the article "How to make a drawing". Here the artist appears confident that the future program will probably achieve a higher degree of creativity:

> In a short time its drawings will be unpredictable, not in the simple sense that Aaron1 's drawings were unpredictable, but in the more profound sense that they were produced by a program which had changed since it was written.[156]

---

[154] Harold Cohen, *On the Modelling of Creative Behavior* (Santa Monica, CA: The Rand Corporation, 1981), 8.
[155] Ibid., 58-59.
[156] Harold Cohen, "How to make a drawing", (paper presented at the Science Colloquium, National Bureau of Standards, Washington DC, December 17, 1982), 15.

This passage could be regarded as Cohen's personal definition of emerging behaviour, quite a demanding definition and a rather optimistic prediction for a computer program. In this article, the artist manifests similar optimism regarding the evolution of computers within society:

> We are living on the crest of a cultural shock-wave of unprecedented proportions, which thrusts a new kind of entity into our world: something less than human, perhaps, but potentially capable of many of the higher intellectual functions — it is too early still to guess HOW many — we have supposed to be uniquely human. We are in the process of coming to terms with the fact that 'intelligence' no longer means, uniquely, 'human intelligence'.[157]

In 1983, Cohen seems very confident about the future evolution of his program. Over the course of the succeeding decades, his position towards computer and artificial intelligence will nevertheless reconsider these optimistic predictions.

2.2.4 On Artificial Intelligence and the Evolution of *AARON*

During the first decade of its existence, between 1973 and 1983, *AARON* produced black and white drawings, which would sometimes be coloured and signed by the artist himself. In this early phase, the artist was mainly addressing problems such as the ability of the machine to differentiate between figure and background, between open and closed forms and between inner and outer surfaces. At the beginning of the eighties, Cohen reprogrammed *AARON*, unhappy with its previous results, and decided to deeply focus on the process of generating figurative forms. He thus felt it was important that *AARON* had a memory to store all his drawings and all the rules, a model that was inspired by the functioning of human intelligence, on the one hand, and the activity of painting on the other, in particular as observed in children. The artist was convinced, at that time, that since human intelligence was the only model available to us, it was not unreasonable to use it as a source of inspiration while programming a machine to do an activity such as drawing, widely considered as an activity that necessitates a degree of intelligence. Programming a machine with a knowledge-base, a memory, the possibility to influence new productions from stored information, and eventually creating a

[157] Ibid., 5.

machine that would record its own information, were some of the artist's objectives during this period of time, as attested by his own early articles. Indeed, it could be said that when it came to the challenge of creating a truly independent machine, which would be able to modify itself and to produce unpredictable drawings, Cohen set high expectations for himself. These goals - and the approaches to reach them – were, to a certain extent, influenced by conventional artificial intelligence research.

In an interview with Curtis Roads for the Computer Music Journal, Cohen clearly associates his vision of his program as a production system, to the artificial intelligence approach, in particular concerning the concept of knowledge:

> One of the ongoing problems in AI is now the representation of knowledge. Production systems are a way of representing knowledge. There isn't a fundamental difference between saying I know something and saying I know the rules for doing something. What the production system represents is the rules for image-making.[158]

It is interesting to note that the Encyclopaedia of Artificial Intelligence, edited in two volumes in 1987, hosts a short article of two columns indexed 'Art, AI in', that is to say, artificial intelligence in art.[159] This article on artificial intelligence in art is exclusively dedicated to *AARON*, which is described as a 'knowledge based […] family of programs' that is 'distinguished for its autonomous creative behaviour'. It is remarkable that an exhaustive encyclopaedia in two volumes totalling 1'219 pages host only one example of an artwork produced using artificial intelligence. Indeed, it is worth noting that this single entry was in fact penned by Cohen himself whose contribution was the result of an invitation.

In this respect, it is also interesting to consider the book published by Cohen, together with his wife Becky Cohen and Penny Nii, entitled *The First Artificial Intelligence Coloring Book: Art and Computers*. The computer scientist Edward A. Feigenbaum, professor at Stanford University, was solicited to write an introduction on the work of the artist for the publication. In it, Feigenbaum recalls the invitation he made to Harold Cohen to spend a sabbatical year at the Stanford Artificial Intelligence Laboratory,

[158] Curtis Roads, "An Interview with Harold Cohen", *Computer Music Journal* 3, no. 4, 1979: 51.
[159] Stuart C. Shapiro and David Eckroth, *Encyclopedia of Artificial Intelligence* (New York: Wiley, 1987).

having previously discovered the artist's work. Of Cohen, the computer scientist affirms that he "sought to use the concepts and methods of artificial intelligence research to shed light on the ways artists make their images. (...) Cohen is dedicated to demystifying art and bringing it back into the hands of ordinary people."[160] Not only does Edward A. Feigenbaum acknowledge the application of concepts and methods of artificial intelligence research in the work of Cohen, he also affirms that the artist uses these tools to '[demystify] art' and to make it accessible to 'ordinary people'. Demagogical as it might appear, this statement reveals how the computer is perceived, or promoted, as a democratic tool, in opposition to the world of fine art, which implies a certain elitism.

Journalist Pamela McCorduck, who has documented the life of Cohen and extensively analysed his work, described *AARON* as a 'semi-intelligent program', an 'artificial intelligence system' and even a 'contingent system'.[161] She pointed out that in developing his own experiments in order to test the application of computing machines to art and his own ideas on cognitive behaviours, Cohen did so independently from scientific research in the AI field. In addition, she reported that it is in particular the 'if-then-(else)' program command that inspired him to write the application to create drawings, while he was learning to program. McCorduck concedes that her book is the result of a long encounter and discussion with Cohen. Although she is responsible for the interpretation of his work, the fact that she mentions an association with artificial intelligence research, but also an independence from it, is certainly the result of a dialogue between the author and the artist.

On some occasions, Cohen admitted his inclination towards artificial intelligence research himself and, more particularly, his preference for symbolic representation when it comes to using machines as a mean to further progress in epistemological knowledge. During a talk held at the Tate Modern in 2004, a member of the audience asked him to comment on the artistic production that had emerged from recent

[160] Harold Cohen et al., *The First Artificial Intelligence Coloring Book: Art and Computers* (Los Altos, California: W. Kaufmann, 1984), 12-13.
[161] McCorduck (1991), 6-7.

developments in artificial life, a development that discarded symbolic representation. Harold Cohen replied that:

> There is an awfully big difference between being able to respond physically to environmental stimuli and being capable of symbolic thought and we see no indication yet at all that the artificial life people are within a million miles of developing the original model into symbolic thinking. (...) You don't make art unless you have a history.[162]

This statement is essential to understanding Cohen's approach, not only in regard to his opinions toward scientific research, but also concerning his preoccupations with developing a computer program in an artistic context. Cohen explicitly refuses to concede that the bottom-up approach, promoted by artificial life research, supplemented and disavowed the traditional one held by artificial intelligence researchers. He also suggests that art-making is possible if there is a background allowing for the comprehension and the organisation of such an activity, as well as a reason to do so, something that cannot be achieved, in his opinion, through generative algorithms alone. And this is also the reason why he kept rewriting his program, trying new directions to further investigate the nature of image-making and attempting new solutions in dealing with forms and colours.

During the eighties and nineties, a decade after *AARON* was first created, the printed works present a clear evolution towards figurative and realistic shapes. Furthermore, the forms started to be coherently organised in interiors or in landscapes displaying organic elements. At first, the artist personally applied colours by hand to the printed works, he later decided that *AARON* should be able to deal with colours independently. It is only at the beginning of the nineties, that he expressly confronted the difficulty of instructing *AARON* to autonomously deal with colours. Cohen used many programming languages through the years, such as "Fortran, Basic, SAIL, Algol and C", and he has been "using Lisp exclusively for the past twenty-five years,"[163] a language that precisely helped him to find a solution to integrate colours into his program. Invented by John McCarthy in 1958, Lisp was commonly considered the favoured language by artificial intelligence researchers.

---

[162] Tate, Blogs & Channel, accessed January 13, 2014, http://www.tate.org.uk/context-comment/video/harold-cohen-artists-talk.

[163] Harold Cohen, e-mail message to author, August 25, 2010.

At the turn of the millennium, *AARON* started producing abstract works displaying a large array of colours. However, the problem of colouring brought the artist to reconsider his formal position regarding intelligence and the way to program a creative machine. While his initial approach matched, to some extent, the principles of AI research based on symbol manipulation and top-down modelling of human intelligence, the solution to the problem of colouring was possible, for the artist, only by diverging from these models and abandoning the idea of an organized knowledge base. In a personal email, Cohen admitted that his early thoughts, illustrated in the article "What is an image?" were "very much under the influence of orthodox AI."[164] Conversely, the current version of *AARON*, as described by the artist, "to the degree that it acts with neither intelligence nor purpose, it resembles a natural system more than an intelligent system."[165] With the ambition to achieve greater autonomy for *AARON*, the artist finally adopted the model of an artificial machine whose functioning relies more on independent local rules instead of on a coherent and organized system.

In a sense, Harold Cohen didn't entirely give up painting when he turned to computers and programming: painting, drawing and creativity in general were precisely the subject of his investigations while he conceived and constantly reprogrammed *AARON*. More than a device to produce commercially valuable and attractive artworks in an efficient and automated fashion, more than a tool, as he so often felt compelled to affirm, his endeavour was to constantly rework and evolve his program in order to better understand the act of image making, and eventually achieve the possibility of producing a truly creative machine that could display a particular kind of emerging behaviour.

Concerning the association of his work to computer art, on the one hand, and to artificial intelligence, on the other, Cohen explicitly expressed his objections in a paper published in 1986, "Off the Shelf".

> I've noticed that the computer art telephone callers are starting to profess a deep

[164] Harold Cohen, e-mail message to author, August 25, 2010.
[165] Harold Cohen, "The Art of Self-Assembly: the Self-Assembly of Art" (paper presented at the Dagstuhl Seminar on Computational Creativity *Computational Creativity: An Interdisciplinary Approach*, Schloss Dagstuhl: Leibniz-Zentrum fuer Informatik, July 2009), 6.

> involvement with Artificial Intelligence: I surely cannot deny my fellowship with that, can I? Oh, but I can! I know where I stand with respect to Artificial Intelligence. I also know the difference between a name that differentiates and a label that prevents differentiation.[166]

In an email exchange, I had the opportunity to question him on his position regarding artificial intelligence, as well as the debate opposing top-down versus bottom-up approaches. He clearly took his distance from both approaches:

> I've argued in one of my papers - on colour - that we are all (all including machines) both enabled and limited by our resources, and that humans and machines don't have the same resources. That argument took me off the standard top-down AI vector; I didn't see how modelling the human colorist was possible. At the same time, I recognised that my program would need a great deal of knowledge about color (and the human perception of color, given that the program is intended to produce work for a human audience) and it never occurred to me that a bottom-up approach could generate that knowledge for itself.[167]

Harold Cohen developed a very unique and personal research project: he learned to use computer languages such as Fortran, C and Lisp to produce his own program in order to approach the question of image making. In doing so, he coherently continued his own activity of painting and his inquiry into the fundamental elements of an image and what it means to create a drawing. While many projects developed within artificial intelligence research were later regarded as failures – as, for example, in natural language procession and translation, or in the area of visual perception –Cohen had successfully created a program capable of autonomously generating paintings that have been exhibited in museums worldwide and appreciated by a large audience. What is undoubtedly unique about Cohen, is the consistency with which he modified and improved the written program in order to progress in his artistic and epistemological research. For the artist, his work was not simply an opportunity to produce drawings, it was first and foremost a means to deepen the understanding of the activity of drawing and the production of meaningful forms.

Cohen was inspired and certainly influenced by artificial intelligence research, although he did not fully associate with its ideology and methodology and preferred to develop his own approach. It is quite clear, from the analysis of his work and his articles, that his

[166] Harold Cohen, "Off The Shelf", *The Visual Computer* 3, no. 86 (1986): 194.
[167] Harold Cohen, e-mail message to author, August 25, 2010.

research was deeply theoretical, epistemological, and aimed at contributing to a better understanding of the functioning of human activities such as creativity and image-making through the use of the machine and programming languages. However conceptual and epistemological his research has been, his focus remains nonetheless inscribed within artistic production and the understanding of the activity of drawing. Cohen clearly expressed his motivations and his position concerning the use of machines in an artistic context in his articles. How has his work and his ideas been discussed by critics and curators? The next section analyses the reception of his work.

2.2.5 Reception of Cohen's Work and Ideas

Before he started experimenting with machines and programming, Harold Cohen received favourable critique for his paintings. In the catalogue published for the British pavilion of the Venice Biennale, he was presented as an artist who "makes his pictorial statement out of an investigation into the semantics of painting itself."[168] As demonstrated in the previous sections, it is precisely this desire to pursue his investigation into the semantics of painting that will motivate him to engage with computing machines after his initial career.

During the first years of presentation of the early computer drawings, the reception, based on an analysis of articles from the time, can be said to be quite positive. Herbert Francke affirmed that: "He created quite a sensation with his remote control drawing machine which he calls turtle because of its looks."[169] In an article for the Encyclopaedia Britannica edited in 1973, Jack Burnham measures the quality and interest of Cohen's work:

> There are a few exceptions to the "pretty pictures" school of computer graphics. For instance, the English painter Harold Cohen is concerned with a "game theory" of strategies for creating paintings according to very primary assumptions. Cohen devises programs based on theories of graphic

[168] David Thompson, "5 Young British Artists", in Bernard Cohen, Harold Cohen, Robyn Denny, Richard Smith, Anthony Caro: Xxxiii Venice Biennale 1966 British Pavilion (London: British Council, 1966), 4.
[169] Herbert W. Franke, *Computer Graphics, Computer Art* (London: Phaidon, 1971), 120.

creativity.[170]

In her publication on the fertile relationship between robots and art edited in 1978, regarding the drawings produced by *AARON,* Jasia Reichardt affirms that:

> The drawings are very different from those associated with computer art, but resemble Harold Cohen's freehand drawings as well as the more uninhibited drawings of young children. The machine demonstrates in one way how such drawings might come about.[171]

Herbert Fancke, Jasia Reichardt and Jack Burnham are specialists in the field of computer art at the time when Cohen creates his first drawings. It is not surprising that the artist and his work generate a positive reaction among them. It is interesting to note, however, that both Jasia Reichardt and Jack Burnham emphasise the distinction between Cohen and other computer artists, mentioning it as a mark of quality, instead of a lack of it. A position that tends to suggest that the average artistic production made with computers, despite the novelty of the phenomenon during the seventies, didn't completely convince even such specialists in the field.

During the period of his early production, from 1973 to 1983, Cohen was invited to present his work in a number of important institutions and exhibitions, such as The Stedelijk Museum in Amsterdam, in 1977, the San Francisco Museum of Modern Art, in 1979, the Tate Gallery in 1983, and the documenta 6 exhibition in Kassel, in 1977. Some of the catalogues published during these exhibitions do not propose a critical text. The catalogue produced on the occasion of the exhibition at the Stedeljik Museum only reproduce a dialogue between the artist and his wife, Becky Cohen. The Catalogue from the documenta 6 exhibition only includes a text written by the artist. For the documenta exhibition, Cohen is included in the category "Handzeichnungen Utopisches Design, Bücher" and, more specifically, in the sub category "Zeichenmaschine", which also included the artists Rebecca Horn and Jean Tinguely. Indeed, it is only several editions later, that the documenta exhibition would host a section dedicated to computer art. In the general introduction to the catalogue, the work of the artist is presented by the curator of the drawing section Wieland Schmied with a single, purely descriptive

[170] Jack W. Burnham, "Art and Technology" in *Britannica Yearbook of Science and the Future* (Chicago: Encyclopaedia Britannica, 1972), 349.
[171] Jasia Reichardt, *Robots: Fact, Fiction, and Prediction* (New York: Viking Press, 1978), 52.

sentence: "The drawing-computer developed by Harold Cohen that constantly creates new drawings from a custom program."[172]

The catalogue of the exhibition at the San Francisco museum, on the other hand, presents a critical text written by Andrew Forge, Dean of Yale University School of Art. The author makes it clear from the start that the drawings are made by a computer:

> We have to be clear what these drawings are not. They are not drawings that Cohen has made and then instructed a computer to reproduce or permute. They have nothing to do with computer graphics. They are original drawings by the computer which, in a sense, makes up its own mind what to do next.[173]

The conclusion of the author concerning the contribution of Cohen to art is of particular relevance, because it provides a qualitative appreciation of his work:

> If I understand him correctly, Cohen is telling us that art is, in the most general and universal sense, a kind of meditation on the power of the mind to symbolize. It is a tonic message, deeply humanistic, and liberating, at least to anyone who has suffered the claustrophobia of the historicist tradition, whether in the form of art historical theory or the strictures of the art scene.[174]

It is worth noting that Andrew Forge stresses the humanistic aspect of Cohen's work, his propensity to make a contribution to knowledge through his research. The author feels compelled to point out that the work of the artist is not about the machine, but rather about art and the human mind.

The catalogue of the exhibition at Tate Gallery, in 1983, proposes a critical text by Margaret Boden. In the text, this time, the author clearly links the work of the artist to artificial intelligence research:

> The interpretative process by which the mind assigns meanings to its ideas are compared to the information-processing specified by complex computer programs – especially those developed in artificial intelligence.[175]

---

[172] "Der von Harold Cohen entwikkelte Zeichencomputer, der nach vorgegebener Programmierung immer neue Zeichnungen schafft." Wieland Schmied, "Formen und Funktionen der Zeichnung in den sechziger und siebziger Jahren", in *documenta 6: 3* (Kassel: Dierichs, 1977), 10, my translation from the German.

[173] Andrew Forge, "On Harold Cohen's Drawings", in *Harold Cohen, Drawing: [exhibition] San Francisco Museum of Modern Art, July 28-September 9, 1979* (San Francisco: San Francisco Museum of Modern Art, 1979), 2.

[174] Ibid., 4-5.

[175] Margaret A. Boden, "Creativity and Computers", in *Harold Cohen: The Tate Gallery [8 June - 24*

At the time of the publishing, Margaret Boden was Professor of Philosophy and Psychology at the University of Sussex and had conducted research in the fields of psychology, computer science and artificial intelligence. Her text for the catalogue of the Tate exhibition follows an introduction written by the artist and is preceded by a text by Michael G. Compton, curator of the exhibition. The choice to invite Margaret A. Boden to contribute to the catalogue suggests that the curator felt important to have a critical text by a specialist in the field of cognitive sciences to better present and discuss the work of Harold Cohen.

Not all the authors that wrote on Harold Cohen, however, have seen the parallel to the computer research as a positive step. Some years later, in the edition addressing the "Ästhetik Des Immateriellen" of Kunstforum, if the work of Cohen is described in positive terms, it is not because of his use of technology, but because it is considered to be an intelligent collaboration with machines in which the artist remains the mastermind: "Despite such electronic 'wonders', we are fortunately still far from the time when art will be literally produced by machines. Ultimately, AARON is nothing more than Cohen's clever assistant."[176] 'Glücklicherweise', resolves David Galloway, the machine is still far from being able to genuinely and autonomously produce art. Galloway's interpretation of the work contradicts, to my understanding, the ambition of the artist, who certainly did not consider *AARON* as simply his 'cleverer Gehilfe', or a tool. However, the essay shows that, for some art critics, the use of computing machines within an artistic context was acceptable providing that the role of the artist was not replaced in the creative process.

The association of Cohen's work to artificial intelligence research persisted beyond the nineties. In her extensive publication on the work of Cohen, as already discussed, Pamela McCorduck described the link with artificial intelligence research. She argues that "Harold Cohen was drawn unerringly toward artificial intelligence, which he didn't

---

July 1983] (Millbank, London: Tate Gallery, 1983), 15.

[176] "Trotz solch elektronischer "Wunder" sind wir glücklicherweise noch weit erntfernt von der Zeit, in der Kunst sprichwörtlich von Maschinen hergestellt wird. AARON ist schließlich nicht mehr als Cohens cleverer Gehilfe." David Galloway, "Die Muse in der Steckdose", *Kunstforum* 97 (1988): 86, my translation from the German.

even know existed as a scientific field"[177] and concluded that to "leap beyond all that, to make a representation of the very process of art-making itself, is Harold Cohen's singular achievement."[178] In the same verve, David Thomas measured the significance of Cohen's work in light of his contribution to the artificial intelligence research. In an edition on computer art of the discontinued Canadian art journal *Parachute*, he wrote that "one of *AARON*'s original contributions is to artificial intelligence research and our understanding of university-based knowledge: *AARON* has proven that certain aspects of drawing activity could share common decision-making processes with other forms of knowledge that can be similarly programmed."[179] The author boldly concludes that "*AARON* stands at a juncture in the evolution of human identity."[180] With the exception of some critics like David Galloway, the majority of critics that discussed the work of the artist, such as David Thomas, compliment it for its involvement with scientific research and the opportunity it offers to contribute to the progress of knowledge.

Harold Cohen turned to computing machines to further develop his understanding of image-making. He deemed it important to master the functioning of computers and of programming languages, and to pursue his research over the course of many decades. On the one hand, the shift from traditional painting to computers could be considered a drastic break in his career, on the other it could be considered a coherent step forward in his research. If the artist turned to machines, it was not for economical or opportunistic reasons, but rather to address epistemological questions that were relevant to him, such as the nature of a drawing and the production of intentional forms. By learning to use computing machines, mastering several computer languages and eventually writing his own program, Cohen was ultimately investigating not only the act of image-making, but also tackling questions related to creativity, intentionality and intelligence. He aimed at creating an autonomous entity that would eventually evolve and surprise its own maker by producing unexpected drawings, thus showing emerging properties and behaviours.

[177] McCorduck (1991), 147.
[178] Ibid., 192.
[179] David Thomas, "Harold Cohen Expanding the Field: The Artist as Artificial or Alien Intelligence?", *Parachute (Extra-Human AI)*, no. 119. (2005): 56.
[180] Ibid., 65.

Concerning his position toward the technology associated to his work, the artist seemed to be between two minds. On the one hand, he often mentioned his relationship and collaboration with his colleagues in the artificial intelligence field. Furthermore, his critical position concerning the bottom-up approach to artificial life and embodied robotics, and his preference for the research based on symbolic representation, further affiliated his artistic and epistemological research to the artificial intelligence field. Critics and curators who commented on his work have equally stressed this affiliation and it is not a surprise that the most exhaustive essays written on the artists are not from art historians but rather from specialists in cognitive and computer science. On the other hand, he often made clear how his goals and perspectives on machines differed to those held by computer scientists, as attested by several articles that he published. Additionally, the evolution of his work, in particular after the creation of a program able to handle the problem of colouring, is coupled with a divergence of his position away from the traditional artificial intelligence approach. What is more, specialists in the field of arts and technology, such as Jack Burnham and Jasia Reichardt, commented on the uniqueness and the quality of his work compared to the average emerging artistic production associated with computer art.

2.3 Edward Ihnatowicz

2.3.1 From Assemblages to Cybernetics

In 1968, Edward Ihnatowicz presented his first cybernetic sculpture at the Cybernetic Serendipity show in London. In the same year, the artist was commissioned a sculpture for the Evoluon, Philip's exhibition space in Eindhoven. The resulting work, *Senster,* is the artist's most ambitious work and a significant one for the history of new media art. The work has been regarded as emblematic of the growing interest in the use of new technologies in art, a domain in which he became a prominent figure. Edward Ihnatowicz was born in Poland in 1926 and moved to Britain in 1943 where he studied at the Ruskin School of Art, in Oxford. During the first years of his artistic career, he focused on sculpture, in particular experimenting with salvaged and recycled materials. Significant biographical information is provided in a publication edited and published by the artist himself.[181] Additional biographical references are provided by researcher Aleksandar Zivanovic,[182] and by the airtist's son, Richard Ihnatowicz.[183] In an interview with Brian Reffin Smith, Edward Ihnatowicz recalls a turning point in his career: after having installed an atelier in his garage in order to create sculptures made out of scrap parts, he learned how to dismantle a car break system and discovered the servo system. He describes that particular moment as follows:

> I can be very precise about when I discovered technology - it was when I discovered what servo systems were about. I realised that when I was doing sculpture I was intrigued or frustrated, because I was much more interested in motion.[184]

---

[181] Edward Ihnatowicz, *Cybernetic Art: A Personal Statement* (Middlesex: E. Ihnatowicz, 1980).
[182] Aleksandar Zivanovic, "The development of a cybernetic sculptor: Edward Ihnatowicz and the senster", in *Proceedings of the 5th Conference on Creativity & Cognition* (New York, NY: ACM, 2005), 102-8.
[183] Richard Ihnatowicz, "Forty Is a Dangerous Age: A Memoir of Edward Ihnatowicz", in *White Heat Cold Logic: British Computer Art 1960-1980* (Cambridge: MIT Press. 2009), 111-117.
[184] Brian Reffin Smith, *Soft Computing: Art and Design* (Massachusetts: Addison-Wesley. 1984), 148.

From that moment, the artist was motivated by a very constant and coherent struggle to achieve a sculpture that would merge his research on motion, behaviour and intelligence. He was equally driven by a constant dissatisfaction with his previous works, as he admitted in an unpublished text, "Portrait Of The Artist As An Engineer".[185] The more the artist developed his research, the more it merged with the fields of science and technology. He believed that an artist should "use the new discoveries to enhance his understanding of the world".[186] His growing interest for science and technology lead him to work as a research assistant in the Department of Mechanical Engineering at University College in London, between 1971 and 1986.

Although Edward Ihnatowicz produced only a few works involving computers and cybernetics and passed away at the age of sixty-two, his activity has been important for the development of computer art and is still mentioned today in several publications. His first work involving the use of hydraulic pistons and electronics was *SAM*, presented at the *Cybernetic Serendipity* exhibition, curated by Jasia Reichard in London in 1968. At first, Edward Ihnatowicz was not directly concerned with issues such as artificial intelligence and emerging behaviour: his preoccupations were more sculptural than epistemological. The idea behind the work was to realise a sculpture in which the formal choices resulted from functional imperatives, similar to the way that industrial components are shaped by utilitarian ends. *SAM*, the title being a short form for 'sound-activated mobile', was an interactive sculpture or, in his own words, his first "attempt to provide a piece of kinetic sculpture with some purposefulness and positive control of its movement" and, in his opinion, "the first moving sculpture which moved directly and recognisably in response to what was going on around it."[187] *SAM* was composed of several materials traditionally used in industrial design such as aluminium castings and fibreglass, enhanced by hydraulic pistons, microphones and an analogue circuit. The sculpture had an anthropomorphic shape and resembled a head mounted on a long mechanical neck. The head was composed of a four-leaf clover-like shape of fibreglass with the capacity to converge the sound to four microphones spreading horizontally and

[185] Edward Ihnatowicz, *Portrait Of The Artist As An Engineer* (Book proposal, unfinished and unpublished, date unknown: at least pre-1988, found in his papers, published on the internet: http://www.senster.com/ihnatowicz/articles/index.htm), 5.
[186] Ihnatowicz (1980), 4.
[187] Ihnatowicz (1980), 6.

vertically from its centre. The neck was alternatively composed of four pieces of aluminium, cast in vertebrae-like shapes, each supporting hydraulic pistons which allowed the whole sculpture to twist and bend and so that the head could be directed toward a particular source of sound. Unlike works from Alexander Calder and Jean Tinguely, where movements were determined by the wind or by motors, *SAM*'s movement actively responded to the environment.

Ihnatowicz explained that the idea behind *SAM* was not merely to stimulate interactivity, but rather to produce an abstract work of art whose aesthetic was determined by functionality instead of arbitrariness. The work is the result of the artist's fascination for industrial components, which he had previously used in his assemblages, as well as his admiration for the work of engineers who could provide a rational explanation for the formal choices of their products. According to Aleksandar Zivanovic, who extensively researched the life and work of Ihnatowicz, the idea of a mechanical head came from a film of a lioness that the artist captured in a zoo, whose head movement fascinated him and which he decided to imitate.[188] This explanation is confirmed by the artist's son, Richard Ihnatowicz, who related his father's interest in animals and their movements which he regularly observed in the zoo.[189] Instead of applying a predetermined movement to the sculpture, he decided to regulate the movement exclusively to sound-response and interactivity, thus removing any possibility of arbitrariness in the design of those components that determined the movement of the sculpture. The artist's aim was to produce a work of art, a sculpture whose aesthetic would be completely determined by operative principles. *SAM* received a favourable response from public and critics. According to the descriptions of some of the critics who visited the exhibition in London, the spectators were truly fascinated by the work and tended to interact with it for long periods of time. For example, art historian Reyner Banham, in his review of the exhibition, praised the formal quality of the work and described it as "about one the most beautiful fragments of sculpture I have

[188] Aleksandar Zivanovic, "SAM, The Senster and The Bandit: Early Cybernetic Sculptures by Edward Ihnatowicz." in *Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts* (Hatfield, UK: The Society for the Study of Artificial Intelligence and the Simulation of Behaviour, 2005), 1-7.

[189] Richard Ihnatowicz (2009), 111-117.

seen in a decade – and the most disturbing."[190] Even though Ihnatowicz's concerns were purely aesthetic in the beginning, aimed at achieving the perfection of functional industrial design, the artist soon discovered that movement, perception and interaction embodied in an artificial system were the central issues of his research. These central questions motivated him to create his most ambitious and important work, *Senster,* to which *SAM* opened the path.

In the following sections, the analysis of the *Senster* will focus on the work and its presentation in Eindhoven, along with an interpretation of texts written by the artist himself and, in conclusion, the articles written on Edward Ihnatowicz and his work.

2.3.2 The *Senster*

In May 1968, Edward Ihnatowicz was commissioned by the Dutch company Philips to create a sculpture for their exhibition centre, The Evoluon, in Eindhoven. James Gardener, the centre's exhibition designer, introduced Ihnatowicz to the executives of Philips. In 1970, two years after the conclusion of the contract, the artist presented his work *Senster*, which was, to a great extent, a more complex and ambitious work compared to *SAM*. According to Jonathan Benthall it was "probably the most technically ambitious computer-based artefact yet made anywhere."[191] Many years later, Eduardo Kac described it as "the first computer-controlled robotic artwork."[192] To give an idea of the complexity of the technology involved in this sculpture, Aleksandar Zivanovic reported that the computer was insured for the equivalent of today 500'000 USD in the shipping invoice.[193] The sculpture was able to move in response to its environment: in addition to responding to sound, as was the case with his previous

[190] Reyner Banham, "Arts in Society: Cap'n Kustow's toolshed", *New Society* 12, no. 208 (1968): 275-6.
[191] Jonathan Benthall, *Science and Technology in Art Today* (New York: Praeger Publishers, 1972), 78.
[192] Kac (1997), 62.
[193] Aleksandar Zivanovic, "SAM, The Senster and The Bandit: Early Cybernetic Sculptures by Edward Ihnatowicz." in *Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts* (Hatfield, UK: The Society for the Study of Artificial Intelligence and the Simulation of Behaviour, 2005), 4.

work, it was also able to respond to movement. The name *Senster* was coined by combining the words monster and sensor, as explained by the artist's son.[194]

The cybernetic sculpture was made of a complex body composed of steel tubes, which were over four meters long and over two meters tall. The sculpture appeared like a robotic animal and was often described as a giraffe: it consisted of a static body with three legs and a long, moving neck with a head-like shape on its end. It was equipped and controlled with the Philips P9201 computer, a 16-bit system with 8k core memory and additional paper tape for external memory.[195] According to the son of the artist, Ihnatowicz learned how to program and eventually wrote the code for the computer to regulate the sculpture, with the collaboration and help of technicians from University College of London.[196] The electrical and computing device controlled the movement, which was powered by an electro-hydraulic servo-system, supplying the power for the movement of the six independent mechanical joints of the neck, each reproducing the articulation of a lobster claw. The head of the *Senster* was equipped with four microphones and two close-range Doppler radar devices that detected movement. The reason Ihnatowicz doubled the input source - responsive to both sound and movement - was that he wanted to provoke a more complex and unpredictable reaction to the movement of the audience compared to his previous work. Jasia Reichardt wrote that the *Senster* "provoked the kind of reactions which one might expect from people who are trying to communicate with a person or an animal. It appeared more as an organic creature that is capable of evaluating the messages that are sent, and responding to them."[197] To render the movement more animal and organic, the artist added to the servo-system a regulating device that he called 'the predictor', which would provide and control acceleration in the movement. Although the *Senster* could have been programmed to provide a large diversity of responses to sound and movement, it was originally programmed to move towards slight sources of movement and sound, such as an animal hunting for prey, and to move backwards from louder sound sources and violent motion, as if frightened.

---

[194] Richard Ihnatowicz (2009),111-117.
[195] Technical information on the Senster are provided by: Jonathan Benthall, *Science and Technology in Art Today* (New York: Praeger, 1972), 174.
[196] Richard Ihnatowicz (2009), 111-117.
[197] Jasia Reichardt, "Art at large", *New Scientist*, 54, no. 794 (1972): 292.

The artist had intended to make the work available to scientists and researchers with the purpose of modifying the assembler code of the sculpture in order to test varied responses to the environment. In this way, the work could be used as a device for testing and improving artificial intelligence programming, thus providing an elaborate tool for scientific research. Geoff Simons, chief editor at the National Computer Centre in England, even affirmed that in the *Senster* the "brain (a computer) has learning abilities and can modify the machine's behaviour in light of past experience."[198] This might be an exaggerated statement and, unfortunately, the author doesn't provide any source to support it. It is likely that Simons erroneously interpreted the artist's claims about the possibility of reprogramming *Senster* in order to improve its responses to the audience and to generate a more lifelike behaviour. However, Ihnatowicz does not assert that the computer can independently reformulates its own program in any of his articles. On the contrary, the artist clearly declared in an interview with Brian Refine Smith that "it was a completely pre-programmed responding system."[199] The assembler code is made available on the website dedicated to the *Senter* by Aleksandar Zivanovic.[200] Several computer scientists and enthusiasts from the Swiss Mechatronic Art Society agreed to examine the assembler code and to provide me with an analysis of its structure, functioning and qualities. Veli Hämmerli, in particular, came to the interesting conclusion that the "Senster program was kept simple and short, it was proven to be functional within the 8 KiloByte (of the Philips Computer) of memory space available. Random Access Memory (RAM) was a huge cost factor in the early computers."[201] This analysis of the assembler code confirms that the instructions have been written in a practical and efficient manner, to regulate the functioning of the complex hydraulic sculpture. The hypothesis that the computer was able to modify its own instructions should therefore be excluded. However, the limited number of descriptions from the author in the comment row of the document and the absence of more detailed documents of higher-level algorithms for the factual regulation of the system prevent complete comprehension of the program.

---

198 Geoff Simons, *Are Computers Alive? Evolution and New Life Forms* (Brighton: Harvester, 1983), 43.
199 Smith (1984), 149.
200 http://www.senster.com/ihnatowicz/senster/senstercomputer/index.htm.
201 Veli Hämmerli, e-mail message to author, October 7, 2014.

The opportunity to work with computing machines seemed to Ihnatowicz the logical way to further investigate the question posed by his previous work. To conceive the *Senster*, the artist felt that he needed to further deepen his technical knowledge, in particular in the field of computing:

> I felt it was time to learn more about digital processing. Digital computing worried me because it seemed to require not only a much better knowledge of electronics than I possess, but also a knowledge of Boolean logic, Venn diagrams and the like. I tackled this problem by first attending a course on fluidics, a vogue technology then, in which the various logic functions of AND, OR and such could be performed by deflecting jets of air in various ingenious devices.[202]

If the computer and the assembler code were in part responsible for the peculiar movement of the *Senster*, this was the result of the care that the artist took to develop the articulations of its body. The artist imitated the joints of a lobster to create the articulations. He chose the lobster's claws because they were easier to reproduce, compared to the ones belonging to other animals, which were more complex.

The starting point for the *Senster* was again the idea to produce a sculpture in which the aesthetic would be determined by functional needs. But by creating this particular work, Ihnatowicz eventually learned that behaviour was what interested him the most. Yet, he was not entirely satisfied by the extremely complex movement and technology of the *Senster* and later admitted that "there wasn't an iota of intelligence in the thing."[203] Additionally, Philips seemed less interested in investing money in the work, as time went by, and finally dismissed it out of the exhibition centre in 1974. As explained by James Gardner, the work was not generating enough interest in the audience and in the press, in the years after its first presentation, and it became expensive to maintain.[204] In its complete form as a cybernetic sculpture, the *Senster* doesn't exist anymore. Today, the structure of the work is still visible at the location of the former Verburg-Holland Company (recently acquired by Delmeco Fishing Technology), in Colijnsplaat in the Netherlands, which was commissioned to assemble the structure. Once dismissed from

---

[202] Edward Ihnatowicz, *Portrait Of The Artist As An Engineer* (Book proposal, unfinished and unpublished, date unknown: at least pre-1988, found in his papers, published on the internet: http://www.senster.com/ihnatowicz/articles/index.htm), 5.

[203] Edward Ihnatowicz, in the interview with Brian Reffin Smith: Smith (1984), 149.

[204] James Gardner, *Elephants in the Attic: The Autobiography of James Gardner* (London: Orbis, 1983), 146.

The Evoluon, the Verburg-Holland Company had it installed on their own campus, as an outdoor sculpture to be appreciated for its aesthetic and historical values. Its electronic components and records are mainly lost, but some dedicated robot engineers, in particular Aleksandar Zivanovic, have been collecting all sort of documents related to the work and distribute them online.[205]

The *Senster* is the most significant work created by Ihnatowicz, both in terms of production and resonance. Subsequently, the artist created a third and last work of cybernetic sculpture, the *Bandit*, which was commissioned by the Computer Art Society for an exhibition at the Edinburgh Festival in 1973. Unsatisfied with the results of his previous work, the artist focused on the possibility of an effective interaction between the public and the machine. Ihnatowicz created the *Bandit* in collaboration with his PhD students at University College in London. The new work mainly consisted of a hydraulically operated lever, powered with pressure sensors and connected to a computer. It looked very similar to a slot machine, primarily because of the presence of the lever which was to be activated by the public. The title recalled the alternative name given to slot machines: the one-armed bandits. The public could interact with the work through the lever, moving it and applying pressure to it; in return, the machine would apply pressure to the lever and register the response from the public. Eventually, the computer would process the information concerning the response of the public from the interaction with the lever and would produce the results, through a printing machine. The results would output the deductions of the machine, based on statistical analysis, about the sex, the age and the temperament of the person involved in the interaction. Jonathan Benthall notes that when determining the sex of the person manipulating the lever, *The Bandit* proved to be accurate 70% of the of the time.[206]

The idea behind the *Bandit* was to further develop the possibility of interaction between the machine and the audience. Ihnatowicz determined that the *Senster* was not truly interactive and intelligent, but was only responding to some pre-programmed behaviour, yet the *Senster* showed the artist that the audience was fascinated by the behaviour of the work more so than its shape. Therefore, he subsequently focused on the idea of

[205] http://www.senster.com/ihnatowicz/index.htm..
[206] Jonathan Benthall, "Computer arts at Edinburgh", *Studio International*, October (1973): 120.

genuine interaction in which the machine would respond to the audience, thus paving the way for a more complex intelligent behaviour. Furthermore, art critics like Jonathan Benthall saw the *Bandit* as being representative of a sexual metaphor, and appreciated the work for its symbolical and artistic significance as well as for its propensity to raise philosophical questions such as "what it means to distinguish an object from a presence."[207] After the *Bandit*, the artist was unable to create any further important works due to lack of funding.[208]

Ihnatowicz hoped that his works, in particular the *Senster,* could become a playground not only for visitors, but also for researchers. His desire was for computer scientists and robotics researchers to visit the Evoluon where they would experiment with the machine and in particular with the computer which directed the impressive sculpture. He hoped that the *Senster* could eventually learn new, unexpected behaviours from its interactions with spectators and from the development of sophisticated programs. In this sense, the work was intended by the artist to display generative qualities. According to Alexander Ivanovic, the artist spent four months, from September to December 1970, in Eidenhover to reprogram the *Senster* and to observe the reaction of the visitors. From these observations, the artist concluded that movement was what mostly intrigued the spectators. Researcher Donald Michie and journalist Rory Johnston, in their promotional book on artificial intelligence and machines, also reported on Ihnatowicz's experiment in which he tried to produce different behaviours:

> He also noticed a curious aspect of the effect the Senster had on people. When he was testing it he gave it various random patterns of motion to go through. Children who saw it operating in this mode found it very frightening, but no one was ever frightened when it was working in the museum with its proper software, responding to sounds and movement.[209]

The fact that Ihnatowicz was experimenting with random patterns is a sign of his intention to create unexpected behaviours. The investigation of complex phenomena such as intelligence and understanding was the central objective of the artist's research. He was convinced that such phenomena could be understood by means of simulating

---

[207] Ibid., 120.
[208] Ihnatowicz (1980), 7.
[209] Donald Michie and Rory Johnston, *The Creative Computer: Machine Intelligence and Human Knowledge* (Harmondsworth, Middlesex: Penguin, 1984), 153.

them in an artificial system. Inhatowicz believed that, in order for a machine to be able to produce behaviours such as thinking, it needed to operate and control a physical device, thus having a purpose and an occurrence in the physical world. Ihnatowicz's central idea is very clear: intelligence is not a phenomenon that can occur in an abstract environment, rather it needs a physical environment in order to emerge and evolve, an environment with which the artificial system needs to interact. Hence, for the artist, two important concepts are related to the concept of intelligence: the concept of perception and the concept of interaction through movement. These concepts are often mentioned in the texts published by the artist during his life. The following section will discuss these concepts in detail and their significance for Ihnatowicz's work.

Figure 11 Evoluon Eindhoven, view of the exhibition and congress centre today.
Photograph by Boris Magrini, © 2015.

Figure 12 Evoluon Eindhoven, view of the exhibition and congress centre today.
Photograph by Boris Magrini, © 2015.

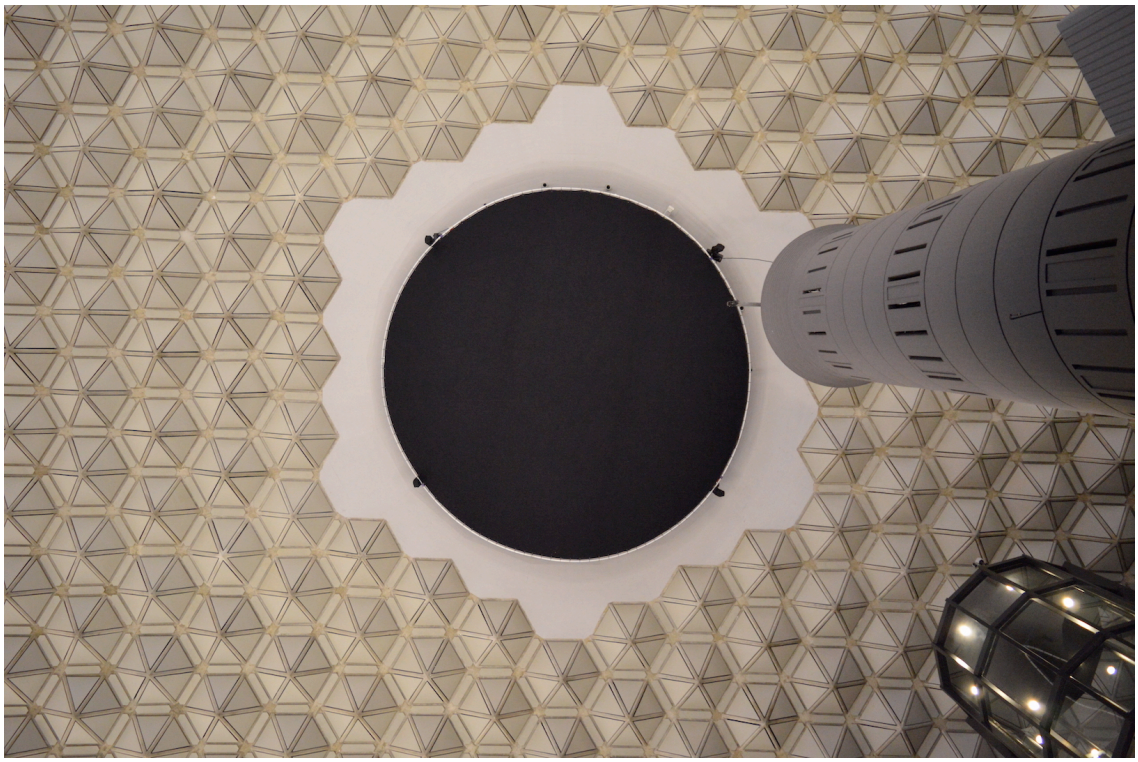

Figure 13 Evoluon Eindhoven, view of the exhibition and congress centre today.
Photograph by Boris Magrini, © 2015.

Figure 14 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands. Photograph by Boris Magrini, © 2015.

Figure 15 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands. Photograph by Boris Magrini, © 2015.

Figure 16 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands (detail). Photograph by Boris Magrini, © 2015.

Figure 17 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands (detail). Photograph by Boris Magrini, © 2015.

Figure 18 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands (detail). Photograph by Boris Magrini, © 2015.

Figure 19 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands (detail). Photograph by Boris Magrini, © 2015.

Figure 20 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands (detail). Photograph by Boris Magrini, © 2015.

Figure 21 View of the remaining structure of the *Senster* by Edward Ihnatowicz in Colijnsplaat, Netherlands (detail). Photograph by Boris Magrini, © 2015.

2.3.3 The Understanding of Understanding

Through his work, Ihnatowicz developed a personal and peculiar approach, not only toward art but also toward specific topics related to technology and in particular artificial intelligence. What were his primal concerns and what was his position with regard to the computing machine and the scientific research associated with it? The constant struggle to achieve what he would consider the ultimate sculpture and his perpetual dissatisfaction with his previous results show that the artist was not only ambitious but that he also had a clear vision of his goals. Additionally, Ihnatowicz seemed to refuse to limit himself to a single domain, be it art, science or technology: he preferred to develop his own approach and to find his own solutions. Because the artist aimed at investigating the functioning of the human mind through the use of computers and robotics, it is comprehensible that his work has been mainly associated with the field of artificial intelligence. He was convinced that "the understanding of understanding must remain one of the most inspiring goals of our civilization"[210] and in order to do so, for the artist, neither the arts alone nor the sciences could achieve this goal.

> Here is a vital and quite intangible problem of equal fascination to an artist and a scientist which, I suspect, will not be solved by either scientific methodology or artistic intuition alone. If through my work, I succeed in making someone aware of the complexity and the depth of understanding of the nature of perception required to solve this problem I shall be more than satisfied.[211]

This statement offers an interpretation of his position about the distinction between artistic and scientific research. It seems that the artist believed in an approach that would combine scientific progress with artistic creativity. According to Ihnatowicz, this was the only possible way to successfully advance in the understanding of intelligence, or, in his words, the 'understanding of understanding'. According to his views, neither science nor art alone will achieve comprehensive knowledge of such a complex process.

---

[210] Edward Ihnatowicz, "Towards a Thinking Machine", in *Artist and Computer* (New York: Harmony Books, 1976), 32-34.
[211] Ihnatowicz (1980), 5.

Artistic creativity was, in his opinion, a necessary complement to the scientific methodology.

If an understanding of intelligence was his main objective, the artist soon discovered that it was through the study of the functioning of perception that some steps could be made in this regard. He expressed his thesis very clearly in one of his few published articles:

> Even more intriguing is the possibility of investigating and simulating the behaviour of complete systems, both natural and artificial and their responses to changing environments because this leads us directly into the realm of perception which, to my mind, is the central problem of intelligent life.[212]

Hence, perception was for Ihnatowicz the key to understanding intelligence and to eventually producing an artificially intelligent behaviour. He also believed that perception could only take place in a moving body, a body that would need to interact and relate to a physical environment. In another article, he expressed this idea:

> It appears that not only is the physical motion of animals, when it is not random, controlled by some form of perception, but perception is equally dependent on some form of motion.[213]

Hence, for Ihnatowicz perception and movement are not subordinate to each other but are rather interdependent. In an unpublished article, distributed online by Aleksandar Zivanovic, the artist further supports this position:

> Our stipulation that the motor output and feed-back are the necessary corollary of any intelligent system suggests that learning or perception cannot take place in the absence of active, physical interaction.[214]

Motion, perception and, ultimately, intelligence were the central concepts of his investigations, the ingredients of his artistic research. According to Ihnatowicz there could be no intelligence without perception, and, in turn, there could be no perception

---

[212] Ihnatowicz (1976). 32-34.

[213] Edward Ihnatowicz, "The Relevance of Manipulation to the Process of Perception", *Bulletin of the Institute of Mathematics and its Applications,* May (1977): 133-135.

[214] Edward Ihnatowicz, " Maggoty Intelligence" (unfinished and unpublished, date unknown: at least pre-1988, found in his papers, published on the internet: http://www.senster.com/ihnatowicz/articles/index.htm), 3.

without motion. From such hypothesis the artist deduced the prescriptions to concretely investigate intelligence through cybernetics:

> It seems likely that the most promising way of investigating the problems of intelligence would be by constructing an artificial organism and observing its performance in a real environment and in real time. (...) concept forming in any machine or organism can only occur in relation to the organism's physical structure and only through a dynamic interaction with its environment.[215]

At a time when computer art started to emerge and the corresponding scientific field was dominated by the artificial intelligence research, Ihnatowicz developed a peculiar position by supplementing his artistic production with a very personal and original interpretation of some ongoing epistemological questions discussed within the cognitive sciences. In keeping with his opinions, the artist focused on creating moving machines instead of complex computer programs. The control of physical motion appeared to him to be the only possible way to approach the question of intelligence, and hence achieve the development of an emerging behaviour in an artificial machine.

Ihnatowicz never used expressions such as 'emerging behaviours', 'artificial life' and 'bottom-up': these concepts and terms would become widely employed only some decades later. Nevertheless, artificial intelligence was very popular at the time when the artist created his cybernetic sculptures, and his work has subsequently been linked to it. The artist himself refers to the artificial intelligence research in his own articles. What were his opinions regarding this scientific discipline?

Brian Reffin Smith, during an interview with the artist, asked him directly about his opinions on artificial intelligence research. Ihnatowicz confesses his scepticism towards that scientific field:

> Brian Reffin Smith: Is this where you tend to diverge from conventional artificial intelligence work?
> Edward Ihnatowicz: I think so, yes. I am firmly convinced that thinking can never be demonstrated in a computer unless that computer is a controller for some physical device. The complete cycle of perception, response and observations on the effect of the response on the thing perceived must be included.[216]

[215] Ibid., 5.
[216] Smith (1984), 147-155.

If thinking cannot be demonstrated in a computer lacking any physical output, the artist further suggested that thinking could not possibly occur in a system that doesn't have a purpose in a physical environment. However, this was exactly what artificial intelligence research was attempting to do, by envisaging the possibility to reproduce intelligent behaviour in a computing machine, independent of any relation to the physical world. This particular approach is today described as a top-down approach, because it imposes a pre-constructed model of intelligence on the machine and limits the reproduction of intelligence exclusively through programming, rather than allowing potential for interaction with the physical environment. Ihnatowicz criticises this approach because he considers it as being inefficient, as the interview clearly points out. Hence, although his work is often associated to artificial intelligence, in truth his position diverges from the main approach within this field of research, in particular regarding the question of the possibility of reproducing and demonstrating an intelligent behaviour. He further clarifies his ideas in an unpublished paper, found and distributed online by Zivanovic:

> The minimum requirements for a cognitive system are: one directional sensory input, one proprioceptive feedback and one motor output. (...) it would have important implications for such areas of AI as scene analysis and pattern recognition where most of the work is done without any reference to motor functions.[217]

The conditions for an intelligent behaviour to occur in an artificial system, according to Ihnatowicz, necessitate interaction with the environment through sensory and feedback tools and a motor device enabling the system to respond to inputs. In other words, the artist believed that intelligence would not emerge from a finite and isolated program but rather through the physical interaction with the environment.

Perception, movement, and interaction in a physical environment: those are the problems that Ihnatowicz focused upon through his life and work. He was convinced that artificial intelligence could not be possible unless these questions were successfully dealt with and solved in an artificial system. This position strongly disagrees with the idea that artificial intelligence can be simulated and programmed in a machine by means

[217] Ihnatowicz, "Maggoty Intelligence", 2.

of symbolic computation alone, a position that dominated the first thirty years of artificial intelligence research. A decade after the creation of the *Senster*, roboticists such as Rodney Brooks in the Untied States, Luc Steels in Belgium and Rolf Pfeifer in Switzerland, questioned the validity of the symbolic computation approach in the fields of robotics and proposed a revolutionary approach, stressing the importance of adaptive behaviour. Their main idea was that a machine wouldn't be able to evolve and thus truly develop intelligent behaviour unless it were given the time and the possibility to do so in a physical environment. Humans learned and developed intelligence by living and interacting within their environment, and according to Brooks, the same process is necessary for machines and artificial systems if they are to evolve and display intelligent behaviour. The American robotic scientist described his main idea in a famous article published in 1990:

> Nouvelle AI is based on the physical grounding hypothesis. This hypothesis states that to build a system that is intelligent it is necessary to have its representations grounded in the physical world. (...) Accepting the physical grounding hypothesis as a basis for research entails building systems in a bottom up manner.[218]

This argument is somehow similar to the one proposed by computer scientist Christopher Langton in his definition and description of artificial life:

> The most promising approaches to modelling complex systems like life or intelligence are those which have dispensed with the notion of centralized global controller, and have focused instead on mechanisms for the distributed control behaviour.[219]

Langton stressed the significance of interaction between multiple machines in order for them to generate intelligent behaviour, in a fashion similar to the swarm intelligence approach, or to the concept of the society of mind proposed by Marvin Minsky.[220] Langton's position, nonetheless, corresponds with that proposed by Rodney Brooks in affirming that intelligence cannot be reproduced by a top-down programming process, but rather evolves from an artificial system that needs to deal with simple tasks and has the possibility of interacting with other artificial systems and their environment. Brooks

---

[218] Rodney A. Brooks, "Elephants Don't Play Chess", *Robotics and Autonomous Systems* 6 (1990): 5.
[219] Christopher G. Langton, "Artificial Life", in Artificial Life: The Proceedings of an Interdisciplinary Workshop on the Synthesis and Simulation of Living Systems, Held September, 1987, in Los Alamos (Redwood City, Calif: Addison-Wesley Pub. Co., Advanced Book Program, 1989), 21.
[220] Marvin L. Minsky, *The Society of Mind* (New York: Simon and Schuster, 1986).

and Langton are two of the most important figures in what is today known as the bottom-up approach in robotics, artificial intelligence and artificial life. Their approaches to explanatory models of intelligent behaviours are associated with embodied cognitive science. Their position is now considered a turning point in the development of AI and robotics and it is indeed interesting to note the way in which Ihnatowicz's ideas overlap with a stance that would later create a scission in scientific research.

In his writings, the artist affirms the importance of movement, perception and interaction as fundamental elements in the conception of an intelligent machine. The similarities between Ihnatowicz and researchers like Brooks and Langton not only demonstrate that the artist was a forerunner in his approach regarding the question of intelligence and robotics, it also strengthens the supposition of his disagreement with traditional artificial intelligence research, as already expressed in his interview with Brian Reffin Smith. However, his work was commonly associated with artificial intelligence by the majority of critics and historians. This association is comprehensible, given that during the years of his artistic production this discipline was the dominant one. In retrospect, it is nonetheless inaccurate. On the one hand Edward Ihnatowicz rejected the dominant approach of artificial intelligence research, believing that it would not achieve concrete results, yet on the other he affirmed the need for collaboration between the arts and the sciences. In conclusion, Ihnatowicz was passionate about the idea of merging the arts and the sciences and encouraged artists to embrace new technologies. He believed that this collaboration would ultimately lead to a better understanding of the human mind, more specifically, and of knowledge in general.

2.3.4 Reception of Ihnatowicz's Work and Ideas

With the *Senster*, Edward Ihnatowicz created a spectacular work for an important venue, commissioned by a leading company in technology and did so relying on important financial and technological support. How did critics and the public respond to this impressive work at the time of its presentation? The work was reviewed and

commented on by art critics and journalists at the time of its presentation, while articles and chapters in specialized books and magazines dedicated to computer art and new media still refer to the work today, although there is not one comprehensive publication, to my knowledge, exclusively dedicated to the work of the artist. In 2012, the Tate Modern dedicated a section of its online exhibition on disappeared works of art, "The Gallery of Lost Art", to the *Senster*. The article concerning the work of Ihnatowicz is featured in the 'Discarded' section of the exhibition's printed catalogue. The suggestive title of the article, 'Corporate Power' implies that the loss of the work is to be attributed to the commissioning company and its ruthless decision to discard the work. Jennifer Mundy, curator of the project, describes Ihnatowicz as "a British pioneer in robotic art", adding that the *Senster* "is remembered today as one of the most important works in the history of robotic and computer art, although it functioned for only four years."[221]

An analysis of articles written on the work of Edward Ihnatowicz during his lifetime provides some answers concerning the reaction of the critics and public. Many articles simply describe the work and its technology. My analysis of the articles aims to provide a qualitative appreciation of the critic toward the work, as well as inferring the reaction of the general public from their description. In particular, I was interested in understanding the critics' perspective of the artist's take on research associated with computing machines. Most of the substantial articles written on Ihnatowicz during his lifetime are from curators and art critics involved in the crossover between the arts and technology. Jasia Reichardt, who presented in her famous exhibition the artist's first cybernetic sculpture, clearly expressed her interest for his work in her essays. It appears that she shared Ihnatowicz's hope that one day a machine will achieve spectacular results in imitating the human capability of understanding. She considers the *Senster* as a significant step in the accomplishment of this hope: "While what Senster does is more fundamental than what it is, the ultimate machine will be a more complete being with the hardware determined by software."[222] Jasia Reichardt associated the *Senster* to some of the traditional programs developed by artificial intelligence research, for example "the program DOCTOR developed in America, where patients had a conversation with

[221] Jennifer Mundy, *Lost Art: Missing Artworks of the Twentieth Century*, (London: Tate Publishing, 2013), 47.
[222] Reichardt (1972), 292.

a computer and were convinced that their partner in dialogue on the teletypewriter was a human doctor sitting in another room."[223] In Reichardt's articles the conviction that art and technology should work together and share the same goal often surfaces. She further affirmed that "Innovation in the field of robotics could well come from art as well as from industrial robotics because the goals of art are not clearly defined and most intangible problems could lend themselves to its ad hoc methods."[224] This last passage suggests that for the British critic and curator, it wouldn't be inappropriate to consider that the artistic production should substantially contribute to technological and scientific progress.

The art critic Jonathan Benthall also praises the collaboration between the arts and technology as put forward by Jasia Reichardt. According to Benthall, it is indeed this specific dialogue between arts and technology that delineates a criterion for the appreciation of Ihnatowicz's work. The critic stresses how the artist exemplifies the union between arts and technologies and how respected he is among the scientific community: "Edward Ihnatowicz is a very respected worker in this field since he conceives of his work as art and yet is taken seriously by scientific researchers in robotics and 'artificial intelligence'."[225] Benthall seems to suggest that the degree of respectability that an artist engaging in new technologies receives in the related scientific field proof of his artistic quality. The critic finally resolves that "the Senster is no monument to an artist's genius but a step towards new forms of creative collaboration on the highest level between scientists and artists"[226] and describes Ihnatowicz as being "among the few artists making real headway."[227]

The posthumous analysis provided by Aleksander Zivanovic equally emphasises Ihnatowicz's contribution to technology:

> Ihnatowicz was remarkable in not only being an artist, but also a talented self-taught engineer. Much of his work was exploring concepts in artificial intelligence, particularly the link between perception and intelligence. His work is still very much relevant in the field of robotics and AI, and now that

[223] Ibid., 292.
[224] Reichardt (1978), 56.
[225] Jonathan Benthall, "Computer arts at Edinburgh", *Studio International*, October (1973): 120.
[226] Benthall (1972), 83.
[227] Benthall (1973), 120.

> computers are orders of magnitude more powerful than those available to him, it is perhaps timely that some of his ideas are revisited.[228]

Zivanovic similarly considers the artist's involvement with scientific research, linking his work to artificial intelligence and robotics, and suggesting that his ideas could significantly contribute to the improvement of these disciplines even today.

The designer of the Evoluon, James Gardner, recalls the collaboration with Ihnatowicz in his autobiographical book, he describes the *Senster* as being "the eighth wonder of the world for eighteen months."[229] Some years later, the *Senster* was still described by Donald Michie and Rory Johnston as "one of the most influential kinetic sculptures ever made,"[230] while Brian Reffin Smith considered its author to be "a mixture of artist, sculptor, engineer, artificial intelligence worker and teacher, his ideas have provided food for thought for many workers in the area" adding that the *Senster* is "probably the single most famous piece of such work in the world."[231]

After the death of the artist, the work is mentioned in publications that mostly retrace the history of computer art and robotics. In his study on emerging behaviours and the artistic use of new technologies, Paul Brown affirms categorically that the *Senster* is "arguably the first great masterwork of the computer art convergence."[232] The work is again mentioned in a text by artist Eduardo Kac, retracing a personal history of new media art. Kac affirms that the *Senster* was "the first physical work whose expression in space (its choices, reactions, and movements) is triggered by data processing (instead of sculptural concerns)."[233] Kac compares Ihnatowicz to two other pioneers of robotic art, namely Nam June Paik and Tom Shannon, yet he affirms that he is "perhaps the least known of the three pioneers."[234] The article by Kac, written in 1997, distinctly shows that only two decades after the success of the spectacular cybernetic sculpture at the

---

[228] Aleksandar Zivanovic, "SAM, The Senster and The Bandit: Early Cybernetic Sculptures by Edward Ihnatowicz." in *Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts* (Hatfield, UK: The Society for the Study of Artificial Intelligence and the Simulation of Behaviour, 2005), 7.
[229] Gardner (1983), 146.
[230] Michie and Johnston (1984), 153.
[231] Smith (1984), 147-155.
[232] Paul Brown, "Emergent Behaviours; towards computational aesthetics", *Artlink* 16, Nos. 2-3 (1996).
[233] Kac (1997), 60-67.
[234] Ibid., 60-67.

Evoluon, the significance and renown of Edward Ihnatowicz starts to fade, even within the history of computer and robotic art.

The reaction of the public, during the presentation of the *Senster* in the Evoluon, is also reported in the articles written on the work. Jonathan Benthall witnessed a marked interest from the public, concluding that "it will be easier to say how fully successful the *Senster* is when it has settled down with the half a million visitors who come to the Evoluon annually, and with the scientists who wish to experiment with it."[235] A decade later, Donald Michie and Rory Johnston recall that "the crowds at the Evoluon in Eindhoven, Holland, where it was on show reacted with enormous excitement. Children would shout and wave at it, call it names, and even throw things."[236] Similarly, Ans van Berkum and Tom Blekkenhorst write that "the Senster was the star of Evoluon in Eindhoven, Holland: so much so that the electronics company who commissioned it apparently grew jealous that spectators spent hours watching it, rather than the deeply wonderful displays of light bulbs, and eventually 'killed' it."[237] Aleksandar Zivanovic, concludes in his research that: "People seemed very willing to imbue it with some form of animal-like intelligence and the general atmosphere around it was very much like that in the zoo."[238] These comments don't leave any doubt about the enthusiastic reaction of the public and the interest that it generated.

The examination of the articles and texts written on the artist permit several conclusions to be drawn. Ihnatowicz was considered an influential artist during his lifetime, in particular by critics and curators interested in the use of computer and technology in art, and his work has often been associated with artificial intelligence research. Furthermore, his work, in particular the *Senster*, appealed to a wider public and was considered a spectacular installation during its exhibition. While it is perhaps easy to understand the positive reaction to the work by a public of families and children, it is

[235] Benthall, Science and Technology in Art Today, 83.
[236] Michie and Johnston (1984), 153.
[237] Ans Berkum, Tom Blekkenhorst and F. Blij. *Science [star] Art* (Utrecht, Neth: Fentener van Vissingen Fund, 1986) 58-59.
[238] Aleksandar Zivanovic, "SAM, The Senster and The Bandit: Early Cybernetic Sculptures by Edward Ihnatowicz." in *Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts* (Hatfield, UK: The Society for the Study of Artificial Intelligence and the Simulation of Behaviour, 2005), 4.

nevertheless interesting to consider that the artist was very well received during his lifetime by specialists working on the intersection of the arts and technologies. In recent times, the artist has been described as a pioneer, though many critics and historians admit that today's artistic community has largely forgotten him. What is even more important to note, is that almost all the articles on the artist often ignore any aesthetic considerations or formal descriptions of his work and rather focus on its technological aspects. While active as an artist, Edward Ihnatowicz was unanimously acclaimed as being a great engineer. His work and his artistic contributions were appreciated mostly because of his expertise in approaching its goals, an approach that was described as bearing many similarities to a scientific one. Rather than praising the aesthetic or conceptual qualities of his work, it is the artist's technological achievements that were emphasised in the articles dedicated to him. From these considerations we can conclude that, in the early years, critics and curators interested in the use of computers within an artistic field seriously considered the possibility of artists contributing to scientific research, a contribution that was important for establishing some criteria to judge the quality of their work.

Financed by a private company, the exhibition at the Evoluon was a major one and an example of an exhibition with a focus on art and technology. The years prior to the presentation of the *Senster* saw the foundation of the Computer Art Society in London and of the Experiments in Art and Technology (EAT) network in New York, officially lunched in 1967, as well as the creation of *Leonardo*, which is today a leading publication for the intersection of art and technologies. The question of the separation between new media art and contemporary art did not exist at that time. Quite the opposite: some art critics and curators like Jack Burnham and Jasia Reichardt believed that new technologies were the future of contemporary art. Analysis of the *Senster*, its context of creation, the motivation of the artist and the reaction of the public and the critics, suggest that the use of technology in an artistic context was, during these years, driven by a genuine hope that it could contribute to the development of science and society. However, this optimistic approach to new technologies was mostly fostered by critics, curators and companies such as Philips who were willing to finance artistic events. From the artists' perspective, the approach to scientific research in artificial

intelligence and to the computing machine has to be understood in terms of a very personal and visionary conception of the dialogue between the arts and the sciences, as is exemplified by Edward Ihnatowicz.

2.4 Art, Computers and the Contribution to Knowledge

Harold Cohen and Edward Ihnatowicz developed a very personal use of computing machines in order to pursue their artistic explorations. Both of them wrote articles in which they presented and discussed their visions and their research. Although they produced works of art distinctive from one another, they also addressed similar issues. They developed a profound knowledge and expertise of the technologies without simply exploiting the machine as a tool for their artistic ends. They both shared the desire to contribute, through their work, to a better understanding of the functioning of the human mind and the abilities associated with intelligence and creativity. Finally, they aimed to create an artificial system - be it a cybernetic sculpture or a program running in a computer - that would display what would today be called an emerging behaviour. However, Ihnatowicz and Cohen's approaches and opinions do diverge at point. Most of these differences result from the nature of the works and are important to our understanding of their specificities. These particular aspects are, more precisely: interactivity, formal qualities, relevance and complexity of the code involved and, lastly, the idea of how to reproduce a human-like behaviour in a machine.

When comparing the works of the two artists, what is most striking is the importance attributed to interactivity. For Ihnatowicz, interactivity is not only one among many qualities of the work, but it is possibly the most important, fundamental aspect of it. In *SAM* and in the *Senster* the sculptures react with their own movement to sounds and noises made by the audience, thus allowing the spectators to interact with them: children, in particular, were observed to be extremely excited by the opportunity to play with the moving sculpture. In the *Bandit* the possibilities of interaction are further explored: the work was able to respond to the actions of the spectator with a judgment in a printed form. The artist expressed his belief that only through interactivity the work

would be able to display a realistic behaviour. According to Ihnatowicz, therefore, interactivity was the most important aspect of his artistic research as it was the key element for the production of emerging behaviour.

In Harold Cohen's work, conversely, there is absolutely no interactivity between the work and the spectator. The spectator has no influence over the work and the way it functions, nor on the drawings and paintings that the work generates. The artist stated explicitly in numerous publications, that *AARON* is not a tool and there is no interaction between it and the spectator. Once *AARON* has been programmed by its author and once it is started, it works on its own. If the artist constantly reprograms his work to improve the quality but also the autonomy of the machine – which could be considered an interaction between the author and the work - this interaction takes place during the production of the work and it is not a quality of the work itself. Edward Ihnatowicz had wished that the *Senster* would be constantly reprogrammed in order to display increasingly complex behaviour, a wish that remained unfulfilled. This is exactly what Harold Cohen did with *AARON* throughout his life. What is more, Cohen admitted at one point that he eventually hoped to produce an autonomous machine, a machine that would be able to adapt itself in a substantial way, thus ultimately excluding the need for its author to reprogram it. This radical position by Harold Cohen seems to have been abandoned in recent times: the artist decided to begin a new dialogue with *AARON* by painting by hand the printed drawings produced by the program, as in the first decades of its existence. However, *AARON* continues to produce drawings independently without any interactive process. The difference of interactivity involved in the works of Ihnatowicz and Cohen is representative of their visions for an efficient artificial system.

Although the analysis of the works of the two artists often concern the investigation of the technologies employed, it is also interesting to consider their formal qualities. The works created by Ihnatowicz are interactive, cybernetic sculptures made predominantly of cast aluminium and steel parts which are powered by electrical wires and hydraulic systems. As sculptures, they are unique pieces with finite dimensions and forms. Unequivocally, Ihnatowicz's works display aesthetic qualities. Although these qualities have unfortunately been often ignored by the majority of art critics who considered his

works, the artist admitted to having put a lot of care into designing the individual pieces that made up his sculptures. In truth, his works were initially motivated by a formal intent, namely the objective to create a sculpture whose shapes were dictated by its functions, thus transposing to the field of art the imperatives of modern design. Working on the formal qualities of a sculpture was the initial purpose, the starting problem of the artist, one that would hunt him through his entire career. The aesthetic qualities of the sculpted parts were likewise supposed to contribute to the works potential interactive capabilities. Indeed, in Ihnatowicz's sculptures interaction relied on movement, which in turn depended on the formal solution of the whole sculpture and each of its individual components. In addition, the aesthetic qualities of the individual parts further contributed to the sculpture's life-life behaviours, both in terms of its movement and its general shape. The fact that the artist paid so much attention to the formal qualities of his works, is coherent with his artistic visions and goals in creating a seemingly living, moving sculpture.

The question of formal qualities is more difficult to consider in the work of Harold Cohen. Although *AARON* is embodied in a physical object - the hardware - it is not a unique and finite work: it evolved over the course of a number of decades, and consequently changed its physical characteristics on several occasions. However, the physical object is not necessarily determinant for the uniqueness of the work. *AARON* could, indeed, be described in terms of its hardware and physical features and be appreciated for the aesthetic qualities of the design and shapes of the machinery that runs it. But *AARON* is a computer program, independent of any physical support. If the task of appreciating its aesthetic qualities is to be taken seriously, it would be more appropriate to consider the formal aspects of the written program - be it in Fortran, C or Lisp – in order to evaluate, for example, how some programming problems have been elegantly and brightly solved by the author, rather then considering the formal qualities of the hardware involved. This task, however, would obviously provide little insight into Cohen's artistic research and the significance of *AARON* as an artwork. On the other hand, *AARON* does produce physical drawings and these tangible objects, which are created by the program, can be considered for their aesthetic qualities. It is the purpose of the artist to investigate the activity of image-making by creating a program

that can autonomously produce such objects. It is therefore important that these drawings possess aesthetic qualities themselves, if they have to fulfil their status of drawings, instead of being simply contemplated as randomly generated marks on paper. The question of the formal qualities, in Cohen's work, is thus extremely complex and difficult to grasp. As a work, *AARON* is completely alien to any aesthetic consideration, yet the aesthetic qualities of its productions, - justifying its very nature - are extremely relevant. The drawings produced by *AARON* are, after all, the result of *AARON* as a creative machine; they allow the audience to appreciate *AARON* as a producer of artworks. In a way, one could consider that the aesthetic qualities of *AARON*'s works are the expression of its peculiar creative behaviour, its identity and stylistic consistency. Consequently, to affirm that formal qualities are completely irrelevant in Cohen's work would be a mistake, yet the artist deals with them in a completely different way compared to Ihnatowicz. While Ihnatowicz paid much attention to the formal aspects of his works, as a sculptor would do, for Cohen the aesthetic qualities are absolutely irrelevant for the appearance of *AARON* itself, but are fundamental for its activities and its identity, in a more conceptual manner. If Ihnatowicz worked on the aesthetic qualities of his sculptures while creating them, in order to imitate a living behaviour, Cohen contemplated the nature of aesthetic qualities while programming his work to create an autonomous drawing machine.

Both artists have employed computer technology and have consequently developed a programming language for their artistic purpose. They have been commonly associated with research in artificial intelligence because of their use of computers and their attempt to imitate some aspects of human intelligence with them. What is the relevance and the complexity of the code source involved in their works? Computer technology was exploited only in Ihnatowicz's second work, the *Senster*. The program developed was mainly applied to regulate the hydraulic pistons and the sensors in order to provide the work with an interactive movement. The artist admitted that the computer program was quite simple and he wished that other computer engineers could have experimented with it in order to improve on the original version. Aleksandar Zivanovic describes the program with the following words:

> *Senster*'s program was written by Ihnatowicz himself. You can tell from the

> style of the code that he was not a professional programmer (I wish he'd put in more comments!) but the code is remarkably sophisticated. He got some help from Peter Lundahl, the Evoluon sysadmin, who also added refinements to the software after Ihnatowicz left at the end of 1970.[239]

Although Aleksander Zivanovic admits that the *Senster*'s code was 'sophisticated', it was nevertheless a functional code that simply directed the movements of the sculpture to be attracted or repulsed by sounds and movements. In fact, Ihnatowicz never really developed or aimed at developing a very complex computer program, because he didn't believe that an intelligent system could be accomplished through programming and symbolic representation alone. The technology which he mastered, in order to create his work, was associated with mechanics and cybernetics, rather then programming. In his words: "Computers can deal only with numbers and we are very far from knowing how we could represent numerically not only values but such concepts as colour, mass, speed or indeed such basic ideas as what and where."[240] If in the *Senster* the computer program played only a marginal role, in *AARON* the programmed code is the very essence of the work. *AARON* is the code that its author is constantly rewriting and updating. The artist learned how to write and program in several languages before turning to Lisp, which he found efficient enough for his purpose and has used it ever since. Although the source code is not publicly accessible, the artist has described its functioning, the technical problems he faced and how he managed to solve them in detail. Before using a large inkjet printer, Harold Cohen also built some plotter and turtle devices for the production of the paintings, yet the objectives that the artist was aiming at were not solved in the hardware alone but rather in the code itself.

Both artists intended to create artificial systems that would display emerging properties, although this specific expression is not used in their publications. They nonetheless diverged on how to achieve such goal. In Ihnatowicz's case, these properties would be displayed in a sculpture supposedly capable of acting and reacting in a life-like manner while altering its behaviour based on its interaction with the audience. His sculptures display - through their sculpted parts, their peculiar movement and their possible interactions - some features that surpass the properties of their individual elements and

[239] Aleksandar Zivanovic, "Technical Info about the Senster", accessed 22 August 2012: http://www.senster.com/ihnatowicz/senster/senstercomputer/.
[240] Ihnatowicz (1980), 5.

surprise the audience for their affinity with organic, animal behaviour. Ihnatowicz affirmed that "concept forming in any machine or organism can only occur in relation to the organism's physical structure and only through a dynamic interaction with its environment."[241] Hence for Ihnatowicz, the reproduction of an emerging behaviour, in this case a cognitive one, has to be generated in a machine that is able to operate, through sensors and interactive movement, in a physical environment. In Cohen's case, these properties would surface with the creation of a computer program capable of modifying itself and creating drawings that would surprise even its own author. Cohen's considerations regarding cognitive behaviours are exposed in an article published in 1995, in which he also explains the intellectual motivation behind his research:

> *AARON* began its existence some time in the mid-seventies, in my attempt to answer what seemed then to be — but turned out not to be—a simple question. 'What is the minimum condition under which a set of marks functions as an image?' On the simplest level it was not hard to propose a plausible answer: it required the spectator's belief that the marks had resulted from a purposeful human, or human-like, act. What I intended by "human-like" was that a program would need to exhibit cognitive capabilities quite like the ones we use ourselves to make and to understand images.[242]

He programmed *AARON* in order to enquire about those minimum conditions. In the artist's opinion, the work would challenge our notions of intelligence and creativity because it would be capable of autonomously producing objects that are usually considered the result of an intentional human-like cognitive act. Emerging properties such as the possibility of displaying 'cognitive capabilities', in Harold Cohen's view, arise in the program's faculty to autonomously deal with forms and colours and to create unpredictable results. Unpredictable to such extent that it would be impossible for the audience to assert whether or not the drawings created by the program are the result of a purposeful, cognitive act.

Both Ihnatowicz and Cohen aimed to produce an artificial system, be it a cybernetic sculpture or a computer program, which would challenge our notions of peculiar human activities such as intelligence and creativity, eventually building a machine that would surprise the spectator with an unpredictable behaviour. While Edward Ihnatowicz

---

[241] Ihnatowicz, "Maggoty Intelligence", 5.
[242] Harold Cohen, "The further exploits of Aaron, painter ", *Stanford Humanities Review* 4, no. 2 (1995): 141-158.

believed that interactivity was the key to creating living behaviour, a belief arising from his observations of organic life forms, Harold Cohen believed that machines and humans are fundamentally different and don't share the same environment, leading him to concentrate his efforts on investigating the nature of drawings.

During the early years of computer art, two of the most significant pioneering artists believed that they could use computing machines in an artistic context to create works capable of surprising their spectators and challenging assumptions concerning intelligence and creativity. Be it through movement and interaction with the environment, as in the case of Edward Ihnatowicz, or through the autonomous activity of drawing by a machine, as in Harold Cohen's work, the two artists aimed at reproducing and imitating, through an artificial system, some peculiar behaviours commonly attributed to living beings. They both believed that a deep understanding and mastering of the technologies employed was essential to obtain the artistic quality they aimed at, as well as a means of deepening their approach. The majority of critics and historians have appreciated this aspect of their works by celebrating their innovative role in the use of technologies associated with computing machines and their applications. The association of the work of the two artists with scientific research, in particular cybernetics and artificial intelligence, has been equally emphasised in most of the articles written on them. On the other hand, Ihnatowicz and Cohen truly developed a very personal exploration of the technologies that they employed, independent from the philosophy and the approach advocated by the scientific research to which they were constantly linked. Above all, the cybernetic sculpture and the drawing program that they created were the result of their personal artistic preoccupations, for the most part addressing questions about how to imitate life through a moving sculpture and how to understand the 'semantics of painting'. These two pioneering artists did not engage in an explicit act of subversion of the computing machine, indeed, quite the opposite. They nevertheless exploited it to explore their own visions and obsessions as artists.

Chapter 3

3.1 Divergent Positions After the Seventies

The invention of computing machines, followed by the development of a variety of fields of research such as cybernetics, robotics and artificial intelligence, excited the imagination of researchers, artists and philosophers. During the seventies, artists like Harold Cohen and Edward Ihnatowicz developed works that exploited the possibilities offered by computers to explore questions pertaining to creativity, perception and intelligence. However, not all researchers and critical theorists were unanimous in their praise of the benefits of the implementation of computing machines within society. Some critics began to question the validity of scientific research associated with computers and digital technologies, as well as the impact of the information revolution on society. What were the positions of those who opposed computers and artificial intelligence, and how influential were their views? Which arguments were put forward when questioning the dangers associated with these discoveries? Furthermore, how has computer-generated art developed since the pioneering years of this kind of production? Can we identify a parallel between the arguments advanced against artificial intelligence research and the positions of some media artists?

In the following sections, I will investigate some important criticisms of artificial intelligence and computing machines, in order to understand the theoretical framework surrounding the oppositional tendencies that have emerged in the current new media art field. I am interested in mapping the perception of the impact of computing machines within society, as well as the reception of artificial intelligence research. Firstly, I will consider the seminal texts written by researchers, critical theorists and philosophers. Then, I will analyse the positions of artists that used computing machines during the eighties and nineties in order to understand the evolution of this artistic practice and to question whether a parallel of the critical discourse against artificial intelligence and computing machines can be found within their discourse, in particular by artists using

generative approaches. This analysis will provide insight into some of the ongoing discussions within the current field of new media art, while also highlighting any shift in perception regarding the place of digital and media technologies within this artistic field.

In order to appreciate the complexity of the evolution of an artistic production, the analysis is less effective if limited to a set group of artists. For this reason, I have preferred to develop my research horizontally and in multiple directions. My method is grounded in media research, content analysis, interviews, data collections and observations. I have researched and analysed a large number of publications, catalogues and essays written on this topic, retaining the recurring names and positions. I have interviewed prominent artists of the period and conducted a detailed analysis of two important institutions for digital and media art: the Ars Electronica festival and the *Leonardo* journal. In addition, a number of dialogues and discussions with a variety of personalities currently working in the media art field have also supplemented my research.

3.2 Opposition of AI and the Computing Machine from Within

Voices of opposition, questioning the validity and morality of artificial intelligence and the dangers of a wider implementation of computing machines within our society, can be found within the discipline itself. In a book first published in 1950 Norbert Wiener, the father of cybernetics, praised the benefits of automation, but at the same time expressed concern about the dangers of society becoming overly dependant on machines. He affirmed that "it is perfectly clear that this will produce an unemployment situation" - Wiener is here referring to the introduction of automated labour – and continues his line of thought to declare that "the new industrial revolution is a two-edged sword."[243]

[243] Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (New York: Avon Books, 1967), 220.

Some years later, in 1964, Hubert Dreyfus was the first philosopher to investigate artificial intelligence research in his controversial article "Alchemy and Artificial Intelligence".[244] In his article, Dreyfus questioned the fundamental ideas upon which the concept of artificial intelligence was based, highlighting the limits of the research and the fragility of its predictions. The article, based on a talk given by the author at Rand Corporation in 1964, provoked significant reaction among researchers, according to Daniel Crevier.[245] The philosopher further developed his thesis in his following publication, *Mind over Machine*, published in 1986, and written in collaboration with Start E. Dreyfus and Tom Athanasiou. The authors expressed their concerns not only regarding artificial intelligence research, but also for example, in relation to the growing use of computing machines as a pedagogical tool in schools. But the strongest attack on artificial intelligence was an epistemological one: the authors contested the primary assumption that the human mind, and its cognitive properties, operates as a complex information processing machine and can thus be simulated and reproduced in a computer.

> Current AI is based on the idea, prominent in philosophy since Descartes, that all understanding consists in forming and using appropriate representations. Given the nature of inference engines, AI's representations must be formal ones, and so common sense understanding must be understood as some vast body of precise propositions, beliefs, rules, facts, and procedures. Thus formulated, the problem has so far resisted solutions. We predict it will continue to do so.[246]

Inference engines, or expert systems, were considered as one of artificial intelligence's highest achievements, and were applied in medical diagnosis, for example. They relied on the constitution of a large knowledge base. By discussing cases in which human understanding relies on common sense knowledge, such as natural-language understanding and learning, the authors argued that artificial intelligence will eventually fail in these domains and will therefore be unable to reproduce cognitive human-like behaviours. In addition to attacking artificial intelligence research on epistemological grounds, the authors further supplemented their critical analysis with ethical

---

[244] Hubert L Dreyfus, "Alchemy and Artificial Intelligence", in *Rand Corporation Paper* (Santa Monica: Rand Corp, 1964).

[245] Daniel Crevier, *AI: the tumultuous history of the search for artificial intelligence* (New York, NY: Basic Books), 120-132.

[246] Hubert L Dreyfus, Stuart E. Dreyfus and Tom Athanasiou, *Mind Over Machine: The Power of Human Intuition and Expertise in the Era of the Computer* (New York: Free Press, 1986), 99.

considerations concerning the future use of computers in education and in management. They warned against the growing propensity to rely on machines instead of human beings in environments necessitating decision-making.

At the end of the seventies, computer engineer Joseph Weizenbaum strongly criticised not only the validity of artificial intelligence research but also its ethical values. For Weizenbaum, "the achievements of the artificial intelligentsia are mainly triumphs of technique. They have contributed little either to cognitive psychology or to practical problem solving."[247] The author deliberately used the term 'intelligentsia' to imply that the people working within this field created a closed group of researchers promoting their positions and protecting their own field. In his opinion, they failed to achieve their goals and to fulfil the promises made to secure the funding of their work and to win popularity among a wider public. But to Weizenbaum, what is more alarming is the increasing automation of additional sectors of our society, which, in his opinion, is inexorably followed by an increased loss of control and responsibilities:

> Modern technological rationalizations of war, diplomacy, politics, and commerce (such as computer games) have an even more insidious effect on the making of policy. Not only have policy makers abdicated their decision-making responsibility to a technology they do not understand - though all the while maintaining the illusion that they, the policy makers, are formulating policy questions and answering them - but responsibility has altogether evaporated.[248]

If Wiener sensed the dangers of an automated society but remained optimistic about our aptitude to control and turn the process of automation in our favour, Weizenbaum affirmed that the implementation of computing machines within society was already producing negative outcomes.

The critical positions in opposition of artificial intelligence based on epistemological or ethical considerations, as put forward by Dreyfus and Weizenbaum, were not the only attacks. Another criticism came from the field of robotics and the new-born field of artificial life. When they surfaced in the eighties, embodied robotics and artificial life strongly objected to the methodology employed by traditional artificial intelligence

[247] Joseph Weizenbaum, *Computer Power and Human Reason: From Judgment to Calculation* (San Francisco: W.H. Freeman, 1976), 229.
[248] Ibid., 239

research, rather than its purpose or its ethical implications. According to computer scientist Christopher Langton, founder of artificial life research, and to Rodney Brooks, eminent developer of subsumption architecture in robotics, the biggest fallacy of traditional artificial intelligence research was its grounding in symbolic representation. Traditional AI tried to generate a specific behaviour in an artificial system by reproducing it in a top-down fashion from a natural system. Both Langton and Brooks suggested that complex behaviours such as intelligence and consciousness cannot be reproduced by imitating a model, but rather have to evolve from simple, basic capacities through interaction with an environment, in a bottom-up fashion. The following passages, the first by Rodney Brooks and the second by Christopher Langton, summarise their ideas:

> Nouvelle AI relies on the emergence of more global behaviour from the interaction of smaller behavioural units. As with heuristics there is no a priori guarantee that this will always work. However, careful design of the simple behaviours and their interactions can often produce systems with useful and interesting emergent properties.[249]

> The key concept in Artificial Life is emergent behaviour. Natural life emerges out of the organized interaction of a great number of non living molecules, with no global controller responsible for the behaviour of every part. Rather, every part is a behaviour itself, and life is the behaviour that emerges from all of the local interactions among individual behaviours. It is this bottom-up, distributed, local determination of behaviour that AL employs in its primary methodological approach to the generation of lifelike behaviours.[250]

These concepts and approaches greatly diverge from research based on symbolic representation and consequently put artificial intelligence in question. Instead of focusing on the reproduction of properties within a system, they focus on the concept of emergence itself, attempting to initiate it from the bottom up. This paradigm shift in approach certainly contributed to the success of these new disciplines. Embodied robotics and artificial life, in which the concept of emergence played a central role, offered not only an alternative to artificial intelligence but also a way to overcome previous criticisms of the field and its unaccomplished promises. Instead of trying to artificially recreate intelligence, or other complex behaviours, the bottom-up approach

---

[249] Rodney A. Brooks, "Elephants Don't Play Chess", *Robotics and Autonomous Systems* 6 (1990): 6.

[250] Christopher G. Langton, "Artificial Life", in *Artificial Life: The Proceedings of an Interdisciplinary Workshop on the Synthesis and Simulation of Living Systems, Held September, 1987, in Los Alamos* (Redwood City, Calif: Addison-Wesley Pub. Co., Advanced Book Program, 1989), 2-3.

focused on the process of the system and its potential to generate a higher order of complexity autonomously. In a way, the process of emergence itself became the goal of the research.

3.3 Questioning Modern Technologies in the Post-Industrial Society

The question of the dangers of modern technologies in post-industrial society has been an ongoing debate within the humanities. A notable example and frequently quoted essay in recent philosophical literature is Martin Heidegger's "Die Frage nach der Technik."[251] Considering the etymology of the word technology, Heidegger affirms that in recent times its meaning shifted from the original significance denoting craftsmanship, intellectual and artistic activities to a newer meaning mostly signifying manufacturing. According to Heidegger, as new technologies are developed, society becomes less aware of the very nature of these technologies. Heidegger uses the example of the hydroelectric power plant which supplanted the ancient windmill to illustrate his concept. The German philosopher doesn't seem to consider new technologies as being negative per se, but assigns the responsibility of understanding their nature and their functioning to the people, thus suggesting a normative approach to the question of technology.

Further developing the thoughts of the German philosopher, Herbert Marcuse examines the exploitations of modern technologies by a capitalist society in his book *One-dimensional Man,* published in 1964. Marcuse attributes the homogenization of the post-industrial society to the emergence of new technologies. For him, "in the face of totalitarian features of this society, the traditional notion of the 'neutrality' of technology can no longer be maintained."[252] As an instrument of the capitalist system, technologies are used by the leading classes to drive consumption. The only purpose of the development of science and technology, in his opinion, is the control of both humans and nature by a small elite:

---

[251] Martin Heidegger, "Die Frage nach der Technik", in *Vorträge und Aufsätze* (Pfullingen: Neske, 1954).
[252] Herbert Marcuse, *One-dimensional Man: Studies in the Ideology of Advanced Industrial Society* (Boston: Beacon Press, 1964), xvi.

> The industrial society which makes technology and science its own is organized for the ever-more-effective domination of man and nature, for the ever-more effective utilization of its resources.[253]

Although Marcuse does not specifically question the validity of artificial intelligence or computing machines, his critique encompasses post-industrial society as a whole, together with its machines and products of commodity. Marcuse holds positivist, rational philosophy as the predominant ideology of post-industrial society and considers it dangerous to the evolution of mankind. He sees the refusal of technology as the only way to escape such a normalised, sterile and oppressive society, suggesting therefore an attitude of rejection and opposition. Contemporaneously to Marcuse, the American philosopher Lewis Mumford developed a similar analysis and conclusion.[254]

In the decades that have followed, poststructuralist philosophers have further developed the critical analysis of modern technologies, stressing their dangers and, most importantly, their exploitation of capitalist society. According to these positions, modern technologies emphasised the discrepancies between the working and the ruling classes and, moreover, contributed to the increase in unemployment arising from a surge in the automation of certain tasks. Such a pessimistic approach is exemplified by the famous essay by Gilles Deleuze "Post-scriptum sur les sociétés de contrôle", published in 1990, in which the philosopher points out that the evolution of technologies has primarily served a society of control determined by the rules of capitalism:

> The old societies of sovereignty made use of simple machines - levers, pulleys, clocks; but the recent disciplinary societies equipped themselves with machines involving energy, with the passive danger of entropy and the active danger of sabotage; the societies of control operate with machines of a third type, computers, whose passive danger is jamming and whose active one is piracy and the introduction of viruses. This technological evolution must be, even more profoundly, a mutation of capitalism.[255]

While Marcuse considered machines to be responsible for the emergence of a one-dimensional society, Deleuze identifies the computing machine as a specific instrument

[253] Ibid., 17.
[254] Lewis Mumford, *The Myth of the Machine* (New York: Harcourt, Brace & World, 1967).
[255] Gilles Deleuze, "Postscript on the Societies of Control" translated by Martin Joughin, *October* no. 59 (1992): 6.

of control in present-day capitalist society. These critiques, pointing out the oppressive nature of technological progress (in particular communicative technologies) are echoed in Michael Hardt and Antonio Negri's renowned work, *Empire*, published in 2000. In their analysis of contemporary colonialism, propagated by what they refer to as 'the Empire', the authors reaffirm the role of computing machines as an instrument of control. What is more, they also established that the control of the production and governance of these technologies by a privileged group of companies has increased the inequalities between countries on a global scale:

> The new communication technologies, which hold out the promise of a new democracy and a new social equality, have in fact created new lines of inequality and exclusion, both within the dominant countries and especially outside them.[256]

Hardt and Negri assert that the corporations running and developing the communication technologies, producing new hardware and software, have an increasing control on the society and territories in which the technologies are implemented. These corporations, which are expanding beyond national borders, are taking part of a new form of sovereignty "composed of a series of national and supernational organisms united under a single logic of rule."[257] On the other hand, the authors reflect on the possibilities of resistance offered by the refusal to adhere to the conventions and rules of this series of national and supranational organisms, namely the Empire. In their view, resistance should also be enacted on a global level.

The radical opinion held by Herbert Marcuse and Lewis Mumford (both of whom advocate for an uncompromising refutation of new technologies) is not the only stance among philosophers. For others the broadening of the debate to include questions of democracy and cultural production, presents an alternative solution to the implementation and regulation of modern technologies in society. One example is found in the essay co-written by Paul Virilio and Sylvère Lotringer, originally published in 1983. The authors express their disillusion with technology and progress:

> Since the eighteenth century - since the Age of Enlightenment, to use the well-known terminology - we have believed that technology and reason walked

[256] Michael Hardt and Antonio Negri, *Empire* (Cambridge, Mass: Harvard University Press, 2000), 300.
[257] Hardt and Negri (2000), preface.

> hand-in-hand toward progress, toward a "glorious future", as they say. (...) Thus, my intention is to say: No more illusions about technology. We do not control what we produce.[258]

The authors elaborate on the danger of a technological world over which individuals have little access, knowledge or control. However, it is within a technological world and not through the refusal of it that Paul Virilio, questioned by Sylvère Lotringer, sees the solutions to improve our society:

> I don't believe we can refuse technology, go back to Year One, so to speak. We can't stop everything to give ourselves time for reflection. I believe it's within the inquiry into technology that we'll find, not a solution, but the possibility of a solution.[259]

Paul Virilio and and Sylvère Lotringer's suggestion of inviting society to discuss and monitor the technologies implemented, is also stressed by Andrew Feenberg, who calls for more debate on the question of technology and the construction of an alternative, modern society:

> Modernization itself, I argue, is a contingent combination of technical and cultural dimensions subject to radical variation. Aesthetics, ethics, and culture can play a role alongside science and technology in the emergence of alternative modernities.[260]

Feenberg introduces the role of culture and artistic production into the debate about new technologies and the part they play in shaping modern society, to conclude that: "a multicultural politics of technology is possible."[261] A similar position was more recently expressed by art historian Frank Popper, who dedicated many publications and curated several exhibitions on the creative use of new technologies in art: "A main thread in this book, and the reason I stress the biographical details of the artists, is my desire to show how technology is - or can be - humanized through art."[262] Popper seems to embrace the conviction that artists should contribute to a better understanding of modern technologies. However, he also suggests that artists can play a role in the evolution of

---

[258] Paul Virilio and Sylvère Lotringer, *Pure War: Twenty-five Years Later* (Los Angeles, Calif: Semiotext(e, 2008), 76.
[259] Virilio and Sylvè Lotringer (2008), 119.
[260] Andrew Feenberg, *Alternative Modernity: The Technical Turn in Philosophy and Social Theory* (Berkeley: University of California Press, 1995), x.
[261] Feenberg (1995), 232.
[262] Frank Popper, *From Technological to Virtual Art* (Cambridge, Mass: MIT Press, 2007), 5.

society by participating, through their works, in the debate around technological progress. In this sense, his argument mirrors Feenberg's.

While progressive philosophers such as Feenberg see the possibility of a humanisation of technology through art and culture, authoritative voices among more conservative thinkers such as Daniel Bell, Francis Fukuyama, and Neil Postman, are more severe in their critique of modern technologies. They argue that society should return to traditional moral values and not delegate important choices concerning its evolution to a restricted circle of scientists and specialists. They advocate for the decision-making to be restored to, religion (Bell), the government (Fukuyama) and the family (Postman) respectively. In *Our Posthuman Future*,[263] for example, Francis Fukuyama warns us against an uncontrolled development of scientific and technological progress and advocates for federal regulation of scientific research. Fukuyama's comments mainly refer to recent fields of research such as bioengineering and evaluating the dangers of eugenics, but his arguments and admonitions concern artificial intelligence, as well. In a short chapter, for instance, Fukuyama affirms that artificial intelligence research simply neglected to understand the role played by consciousness and emotions in human intelligence, predicting that it will most likely fail to achieve its goals.[264]

When it comes to artificial intelligence in particular, a peculiar example of a recent critical stance is that prompted by the visionary ideas of Raymond Kurzweil and Hans Moravec. The two researchers offered an enthusiastic and visionary prediction of the achievements that the evolution of computing machines and artificial intelligence will allow, supported by alleged scientific arguments. Kurzweil's detailed prediction of society provides an admirable example of a confident faith in the success of artificial intelligence research. One of his most extensive books, *The Singularity is near*,[265] synthesises his research and visions. Kurzweil audaciously affirms that the realisation of a complete and effective artificial intelligence will be reality within a couple of decades; such artificial intelligence will be similar in every aspect to the human mind and even

[263] Francis Fukuyama, *Our Posthuman Future: Consequences of the Biotechnology Revolution* (New York: Farrar, Straus and Giroux, 2002).
[264] Ibid.
[265] Ray Kurzweil, *The Singularity Is Near: When Humans Transcend Biology* (London: Penguin Books, 2006).

more efficient. Kurzweil predicts that, in the near future, the human body will inexorably become obsolete, and that technology will also allow for the complete recreation of an individual human mind outside the organic body. This particular moment, the singularity, is described as the fundamental turning point in the evolution of humanity. In Kurzweil's optimistic and somehow uncanny prediction of our future, humans will be able to factually download and upload their brains into non-organic hardware, thus opening the possibility to create a general net of brains connected with each other, and potentially capable of building a completely new society. Kurzweil carefully support his thesis with mathematical arguments, mostly relying on the well-known Moore's law, which describes the exponential evolution of power computation in the production of computer processors. According to Kurzweil, Moore's law supports the evidence that our technology will eventually lead to the creation of a machine with the computational capacities of the human brain. If Kurzweil's visionary predictions inevitably gathered supporters, he nonetheless encountered some opponents with whom he openly compared his theories. As early as 2002, his publication *Are we spiritual machines?* included articles by authoritative voices from the sciences and the humanities that challenged his own predictions, to which Kurzweil replied.[266] Among the opposing authors, eminent personalities such as analytical philosopher John Searl, biochemist Michael Denton and ecologist and artist Thomas Ray were invited to express their opinions. Despite Kurzweil's passionate advocacy for artificial intelligence, his visionary predictions and somehow questionable arguments might have in part contributed to discrediting artificial intelligence research, at least to a portion of the audience. By further developing the myth of an all-powerful artificial intelligence to come, relating it to the vision of the global village and finally promising a future where the machine will eventually overcome the human body, Kurzweil excited not only his supporters, transhumanists and posthumanists alike, but he also strengthened the opinions of those who objected the validity and the credibility of artificial intelligence research.

The visionary ideology exemplified by Kurzweil met severe opposition in the writings of the historian and political scientist Richard Barbrook, a prominent intellectual known

[266] Ray Kurzweil et al., *Are We Spiritual Machines? Ray Kurzweil Vs the Critics of Strong Al* (Seattle: Discovery Institute Press, 2002).

for his contributions in the fields of communication and society. In one of his earliest online articles "The Sacred Cyborg" published in the online magazine Telepolis, he described in mocking terms the researchers in this field, portraying them as nothing more than contemporary mystics who attempt, through modern technologies, to accomplish archaic aspirations and obsessions, such as the autonomous creation of life and the achievement of immortality.[267]

In a later publication, *Imaginary Futures*, Richard Barbrook, further attacks the ideology behind artificial intelligence research, affirming that the goal of creating a thinking machine was a myth and illusion, conceived and sustained by researchers in the field to mislead public and private funding. In Barbrook's view, by creating expectations that would never be fulfilled, the researchers were allowed to constantly preserve their financial support. He further asserted that the real purpose of artificial intelligence was the production of sophisticated technologies for the army and that the epistemological goals expressed by the researchers were merely a way to justify their activities to the public and cover their militaristic objectives. As he affirmed: "the imaginary future of artificial intelligence disguised the original motivation for developing IBM's mainframes: killing large numbers of people."[268] Additionally, Barbrook suggested that artificial intelligence has been elaborated as a lure to serve the leading companies in their deception of the public but also their employees and syndicates. In his view, these companies were responsible for promoting the myth that intelligent machines will eventually free workers from hard labour. According to Barbrook, computers and machines only served the interests of the patrons, increasing profits while producing even more unemployment. In his words: "The imaginary future of artificial intelligence was a way of avoiding thinking about the likely social consequences of the mass ownership of computers."[269] Published in 2007, the strong criticism against artificial intelligence expressed by Barbrook proved that the distrustful positions advanced by researchers and philosophers like Weizenbaum, Dreyfus and Marcuse are still present today.

---

[267] Richard Barbrook, "The Sacred Cyborg", in *Telepolis* (10 September 1996), accessed 21 October 2009: http://www.heise.de/tp/artikel/6/6063/1.htm.
[268] Richard Barbrook, *Imaginary Futures: From Thinking Machines to the Global Village* (London: Pluto, 2007), 50.
[269] Barbrook (2007), 62.

Undeniably, the question concerning advancements in technology and the way in which it conditions society has generated lively debate. Despite the initial enthusiasm for artificial intelligence and computing machines, as the debate evolved these new technologies faced a number of attacks and an increasingly bad reputation. The negative critique of artificial intelligence and computing machines came both from researchers involved in the field as well as from a variety of philosophers and critical theorists. Their arguments can be categorised into two main groups: on the one hand, epistemological arguments focused on the scientific goals of the research and its approaches; on the other, ethical arguments addressing the consequences of the research and its impact on society.

The epistemological arguments against artificial intelligence view the discipline's research goals, including the creation of autonomous intelligence and consciousness, as unachievable. Furthermore, the arguments question the value of this research and whether it makes any real contribute to knowledge at all. Similar arguments have been discussed by researcher Joseph Weizenbaum and philosopher Hubert Dreyfus. Another group of epistemological arguments questioned the approach to traditional artificial intelligence research, accusing it not only of improper goals, but also of using improper approaches to achieve them. These arguments have been advanced by researchers in the field of robotics and artificial life, respectively by Rodney Brooks and Christopher Langton, for instance.

On the other hand, ethical arguments against artificial intelligence and computing machines are usually inscribed in a general critic of post-industrial society and communication technologies. These arguments can be further divided into three groups. A first group of ethical arguments accuse artificial intelligence and computers of serving the interest of capitalist society, and more specifically the interests of the ruling class and the powerful corporations, in which labour is replaced by automates, resulting in unemployment and alienation. These arguments have been discussed by Gilles Deleuze, Herbert Marcuse, Lewis Mumford and Richard Barbrook, for example. Additionally, Michael Hardt and Antonio Negri, point out how information

technologies serve the interests of private corporations acting on a global scale and thus contributing to the disparities between developed and underdeveloped countries. In addition, it should be mentioned that some philosophers such as Paul Virilio, Sylvère Lotringer and Andrew Feenberg advocate for a creative use of technologies in order to prevent the monopoly of knowledge by the ruling class.

A second group of ethical arguments, focusing more specifically on artificial intelligence, points out its complicity with the defence industry. This thesis has been discussed by Norbert Wiener, Joseph Weizenbaum, Michael Hardt and Antonio Negri, and strongly supported by Richard Barbrook.

A third group of arguments, put forward by rather conservative philosophers such as Daniel Bell, Francis Fukuyama, and Neil Postman, have criticised scientific research and modern technologies as being a threat to the fundamental moral values of society. The three philosophers proscribe that scientific research and applications of technological innovation should be regulated by higher moral entities and not abdicated to corporations and researchers alone.

These voices are exemplary of a variety of critical stances towards scientific research. They are not delimited to a geographic area or a specific time span, but they are the answer to the development of the implementation of computing machines in our society. The next section will attempt to establish if these critiques are limited to scientific research and the humanities or if similar arguments have been developed within the artistic field as well.

3.4 Artistic Positions on AI in the Eighties and Nineties

It has not been an unusual practice to complement festivals dedicated to new media art with panels and debates on philosophical and sociological questions about the impact of new technologies on life and society, to which prominent researchers from the humanities and sciences contribute. Artists, critics and curators have further discussed

these issues in their works and writings. In particular, the debate concerning artificial intelligence has received significant attention from artists that were producing works of generative art. The Ars Electronica festival and the *Leonardo* journal have provided fertile ground for the ongoing debate. What were the positions of prominent artists using computing machines on these topics after the seventies? The following section attempts to answer this question, mapping the territory of computer generated art during the eighties and nineties, by examining the work and the position of a selection of prominent artists that not only used computing machines and generative approaches to create works of art, but overtly discussed some of the topics associated with these technologies.

Almost forty years after Jack Burnham's prediction of the outcome of an aesthetic of artificial intelligence, artist and curator Peter Weibel reformulates the significance of the impact of the computer in society and in the representation of the human mind, as well as on the artistic production.

> The current state of development in computer technology represents the pinnacle of technological and scientific research and development, which has accompanied a history of thousands of years of human evolution. It should thus surprise no one if our current perception of the human mind is that of a parallel-processing network computer.[270]

Considering the human mind as the equivalent of a computer - or a network of computers - is the key assumption of traditional artificial intelligence research. Expressed at the end of the nineties, Weibel's statement exemplifies the faith in computing machines and artificial intelligence within the section of artistic community that seeks to promote stronger relations between the arts and the sciences.

The enthusiasm for new technologies and the possibilities it affords to both society and artistic production strongly characterised the work and ideas of another pioneering artist in this field: Roy Acott. The artist envisaged a telematic revolution and the advent of a new society based on connectivity. He affirmed that the relational capacities of human

[270] Peter Weibel, "The Unreasonable Effectiveness of the Methodological Convergence of Art and Science", in Christa Sommerer and Laurent Mignonneau, *Art @ Science* (Wien: Springer-Verlag, 1998), 176-7.

beings, powered by machines, are opening a new, emerging future not only for artistic creation but also for humanity as a whole.

> The very term 'information technology' sounds cold and rather alienating, like the outer offices of some Kafkaesque institution. In fact, the opposite is the case, and computer-mediated networks, in my view, offer the possibility of a kind of planetary conviviality and creativity that no other means of communication has been able to achieve. One reason may be that networking puts you, in a sense, out of body, linking your mind into a kind of timeless sea.[271]

Such a vision was already exemplified in his work *La Plissure du Texte*, an obvious reference to the Roland Barthes's book, *Le Plaisir du Texte*. Among the most famous work created by Roy Ascott, it was conceived for the exhibition *Electra, l'électicité et l'électronique dans l'art du xxe siècle* curated by Frank Popper at the Musée d'Art Moderne in Paris in 1983. The exhibition's central theme was based on a survey of the use of electricity in art. Roy Ascott exploited the ARTEX network[272] to create a work that would involve and connect not only several other participants, mostly artists and student, but also different cities through a world-wide network. A total of eleven cities were involved in the project which began on December 11, 1983 and lasted until December 23, 1983. The work consisted of a collaborative text, revolving around the idea of a fairy-tale using a similar approach to the surrealist method of the *cadavre excquis*. In the press release, Ascott described the project as a "collaborative story telling project using a computer timesharing network of artists located in Europe, North America and Australia."[273] The fable resulting from the collaborative work is a fragmented text written in English and French and composed of descriptive paragraphs, dialogues, as well as some ascii-art images. The second important telematic art project by Roy Ascott, *Aspects Of Gaia – Digital Pathways Across The Whole Earth*, was created for the Ars Electronica Festival in Linz in 1989. As for his previous project, the

---

[271] Roy Ascott, "Art and Telematics: Toward a Network Consciousness", in *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness* (Berkeley: Univ. of California Press, 2003), 187. Originally published in *Art + Telecommunication*, ed. by Heidi Grundmann (Vancouver: Western Front, 1984).

[272] ARTEX network (Artist's Electronic Exchange Network) was created by Robert Adrien X in 1980 at the Vienna office of I.P.Sharp. The purpose was to offer artists an easy and affordable network at the time when internet connectivity was still only available to universities and the army (Arpanet and Usenet). ARTEX network was available from 1980 to 1991.

[273] Roy Ascott, "La Plissure du texte", presse release of the Electra 83 exhibition, Museé d'Art Moderne de la Ville de Paris, 1983, reproduced in *Art Telecommunication* ed. Heidi Grundmann (Vancouver: A Western Front Publication, 1984).

artist implemented the use of networks, in this case EARN, BITNET and I.P.SHARP, to join forces with other artists. More than 100 artists from all over the world collaborated on the project, to which more emphasis on images and sound was given this time. The project was co-directed by Roy Ascott, together with five other artists: Don Foresta, Tom Sherman, Tomaso Trini, Maria Grazia Mattei and Robert Adrian X. The public at Ars Electronica was also able to interact with the artistic material created by the artists involved. *Aspects of Gaia* tackled questions related to the earth as a whole and as a living organism, suggesting references to the ideas of British chemist James Lovelock and his theory of Gaia. It was composed of two pieces displayed at the Brucknerhaus in Linz. On the upper level of the building, a large horizontal screen displayed images and texts coming from the world. The images could then be manipulated by acoustic sensors or with a computer mouse. The second part of the work was installed outside the building: the public was able to join a ride on a trolley installed with LED screens that would display the collected data about Gaia, the earth.

These collaborative works by Roy Ascott depict his positivistic vision of a society that is moved forward by technology. In his article *Gesamtdatenwerk*, originally published in *Kunstforum* in 1989, the artist explains his visionary idea of a society that is empowered by a network created by both humans and machines.

> Computer networking provides for a field of interaction between human and artificial intelligence, involving symbiosis and integration of modes of thinking, imagining and creating, which, from the point of view of art, can lead to an immense diversity of cultural transformations, and which, in science and philosophy, can yield enriched definitions of the human condition.[274]

Although the ideas of Roy Ascott are somehow more visionary, abstract and poetic then the reflections of pioneers such as Cohen and Ihnatowicz, they display a similar and genuine interest in using the computing machine to contribute to the enlightenment of society.

The relationship between computing machines and the arts, are also at the core of Stephen Wilson's investigations, consisting of both artistic productions and theoretical

[274] Roy Ascott, "*Gesamtdatenwerk*: Connectivity, Transformation, and Transcendence", in *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness* (Berkeley: Univ. of California Press, 2003), 223. Originally published in *Kunstforum* 103 (1989).

writings. The American artist is probably best known for his comprehensive study of artists involved in scientific research and new technologies.[275] Wilson obtained his MFA in generative systems and performance art at the Art Institute of Chicago and teaches Information Art at San Francisco State University. Wilson developed his works in a manner consistent with the contemporary art world, by creating complex and interactive installations designed to be specifically experienced in exhibition spaces. His work is characterised by artificial intelligence research and the application of computing machines. One of his most famous installations, *Excursions in Emotional Hyperspace*, shown at the NCGA Art Show in San Jose in 1986, consisted of four dummies arranged in the four corners of a room, each displaying specific and individual attributes to further accentuate their personalities. Each dummy had its own story to tell and started to speak as soon as a spectator approached it. The work *Is Anyone There?*, equally confronted the spectator with artificial characters. In this work, a computer was programmed to recurrently call five different public phones in San Francisco in 1992, the public was invited to answer the call and engage in a conversation with a fictional character directed by a computer. The technology allowed for a short discussion between the computer and the spectator, but the main focus of the artist was on the discussed topics relating to everyday life, and the reaction of the spectators to the machine. In this way, Wilson's works attempted to mirror some goals in artificial intelligence, in particular the possibility of a dialogue and even an exchange of emotions between real people and artificial agents. In his essay, "Artificial Intelligence Research as Art", published in 1995, Wilson explicitly mentions the influence that the scientific research had on his artistic approach. Furthermore, he expresses the belief that artificial intelligence research should indeed pursue ambitious epistemological goals, to which artists should explicitly be invited to contribute.

> At its core, artificial intelligence research is about much more fundamental issues than construction of the next year's model of expert system. The culture desperately needs the definitions of research agendas, the generation of hypotheses, and the pursuit of research questions in this field to reflect the perspectives and wisdom of people from a wide range of disciplines, including the arts and humanities.[276]

[275] Stephen Wilson, *Information Arts: Intersections of Art, Science, and Technology* (Cambridge, Mass: MIT Press, 2002).

[276] Stephen Wilson, "Artificial Intelligence Research as Art", in *Stanford Humanities Review 4.2, Constructions of the Mind: Artificial Intelligence and the Humanities* (Stanford, Calif: Stanford

This passage by Stephen Wilson manifests, on the one hand, his faith in the research and its potential to contribute to society. On the other hand, it criticises the research for its lack of more ambitious goals aimed at the betterment of society and suggests that the formulation of such goals can be done with the collaboration of other disciplines, not the least the arts. This position is very similar to that of Paul Virilio, Sylvère Lotringer and Andrew Feenberg, as previously discussed.

Another notable artist that has integrated the use of computers and the investigation into artificial intelligence applications in art is the American artist David Rokeby. His most notable work, *Very Nervous System,* was presented at the Venice Biennial in 1986. The work consists of an interactive device translating the human body movement into an environment of sounds. But it is another work, *The Giver of Names*, a work in progress started in 1990, which intends to mimic more specifically some of the advancements in artificial intelligence. *The Giver of Names* consists of a computer program that, coupled with a camera and a video projector, is capable of recognising random objects submitted to its attention by a spectator. The computer program is able to recognise the forms of the objects, thus displaying vision recognition abilities, which is possibly one of the most ambitious goals of artificial intelligence research. Additionally, it can perform some speculation about the objects and their functions. However, for the artist, the most significant output produced by the machine is a poetic gesture, inviting the spectator to ponder topics such as the problem of semantic definition, names, objects and identity. Central to Rokeby's reflections is the distinction between reality and virtual reality. The artist warns of the increasing difficulty, in a world dominated by technology, of distinguishing between the two. His ideas concerning new technologies such as computers, the Internet and interactive media in general, seems to be twofold:

> Yes, interactive media can empower and enfranchise. But they simultaneously create new kinds of constraints on abstract and psychological levels, constraints that are more difficult to understand and critique than the familiar biases of the press and broadcast media.[277]

Humanities Review, 1995), accessed 21 October 2009: http://web.stanford.edu/group/SHR/4-2/text/wilson.html.

[277] David Rokeby, "The Construction of Experience: Interface as Content", in Clark Dodsworth, *Digital Illusion: Entertaining the Future with High Technology* (New York: ACM Press, 1998).

The reason why Rokeby engaged particularly with new interfaces permitted by computers and modern technologies, is precisely because of the interactive possibilities that they allow. The artist concludes his essay by affirming that interactivity implies responsibility, and that new technologies should be approaches with caution.

The possibilities opened by the use of computers and the simulation of an intelligent artificial agent inspired many artists to create works in which interactivity played an important role. As in the works created by Stephen Wilson and David Rokeby, these approaches aimed to produce either a realistic dialogue or a creative interaction with the spectators. In this respect, it is interesting to read the writings of Kenneth Feingold, another prominent figure among artists investigating artificial intelligence and its possible applications in art. His first installations, such as *Séance Box No.1,* 1998, and *Head,* 1999, were an attempt to create works that could effectively converse and interact with the spectator, hence pursuing the objective to create an artificial creature imitating and displaying intelligent behaviour. The interest of the artist in artificial intelligence research was motivated by the opportunities it opened for the discussion of philosophical topics:

> But I feel that Artificial Intelligence is not a technical problem, as he would have it; rather, it is a philosophical problem, a question of attaining an understanding not of "what is a brain?" but instead, "what is a human being? What is intelligence? What is thought? What is communication? What are the relationships between the technical aspects of thought, and what we think of as personality?[278]

In a similar way as Stephen Wilson, Kenneth Feingold regards artificial intelligence research as an inquiry into greater ontological and epistemological questions, rather than a technology at the service of industry or the military. This is the reason why he decided to engage with this field as an artist. For this purpose, Feingold admits to having studied the literature around traditional artificial intelligence and having learned to program. He later realized, nonetheless, that the spectators were only interested in testing the effectiveness of the work's intelligence and that they completely ignored the artistic qualities and conceptual intentions behind the works. He eventually lost interest

[278] Ken Feingold, "The Subject of Artificial Intelligence" (paper presented at the *Art and Artificial Intelligence* seminar at the Royal University College of Fine Arts (KKH), Stockholm, Sweden, October 2002), accessed 25 March 2009: http://www.kenfeingold.com/docs/The_Subject_of_AI.pdf.

in his former projects, discarding possibilities of interaction between the spectator and the work to create moving sculptures that would dialogue between themselves, often mimicking philosophical discussions, instead of attempting a realistic dialogue with the spectator. His later works, such as *If/Then* (2001), could be interpreted as parodies of human existence but they also seem to mock the possibility of a veritable artificial intelligence.

With a somehow similar purpose, Japanese artist Naoko Tosa approached artificial intelligence and incorporated computers into her artistic productions to explore emotions and philosophical questions, instead of attempting to imitate scientific research. In her essay, she affirms that the research developed by scientific laboratories "handle emotions in a superficially symbolized forms and fail to encompass such delicate emotional communications like bargaining."[279] In her article, the artist explicitly refers to laboratories like the MIT Artificial Intelligence Laboratory, the Carnegie-Mellon University and the New York University's Media Research Lab. Naoko Tosa has created works exploiting artificial intelligence techniques precisely with the purpose of covering the areas that are usually omitted by scientific research, areas such as emotion, poetry and beauty. Her most exemplary work in this sense is *Neuro Baby*, developed since 1993. The Japanese artist concedes that new technologies and machines sometimes scare public opinion by generating fears about the dehumanisation of society. It is precisely the reason why, in her opinion, it is an artist's duty to understand them and use them, in order not to leave the control and the exclusive knowledge about these technologies to the researchers alone.

But artificial intelligence was not the only scientific field that seduced artists using computers. During the nineties, after the emergence of artificial life and embodied robotics, artists started to produce works drawing on these recent fields. Creator of *The Flock,* Kenneth Rinaldo is one of the most famous artists embracing artificial life to produce impressive installations. *The Flock*, developed in 1992, consists of several mechanical arms hanging from the ceiling and interacting with the spectators by

[279] Naoko Tosa, "Expression of emotion, unconsciousness with art and technology", in Hatano Giyoo, Naoyuki Okada and Hirotaka Tanabe, *Affective Minds: A Collection of Papers Based on Presentations at the 13th Toyota Conference, Shizuoka, Japan, 29 November to 2 December 1999* (Amsterdam: Elsevier, 2000), 184.

swinging around and pulling back and forth. The installation is composed of grapevines, electrical cables, sensor devices and sound captors that detect the presence of the spectator causing the work to react to the volume of the voice, thus reproducing a seemingly live and intelligent behaviour. The artist later developed the work into a larger installation, *Autopoiesis*, composed of a larger number of arms. Kenneth Rinaldo recognizes the influence of the theories of Norbert Wiener both on his ideas and the generation of artists to which he belongs: "Many of these artists were inspired by Norbert Wiener and his writings (…) by modelling natural systems."[280] He also acknowledges the influence of artificial life research and affirms his belief in a joint effort between the arts and scientific research: "the greatest potential for the arts and Artificial Life techniques is that they have presented opportunities (...) to develop true relationships with the computer."[281] Although Kenneth Rinaldo adopted recent artificial life and embodied robotics theories in his artistic production, he did not altogether discard traditional artificial intelligence research. The artist conceded that his work was influenced by the ideas and research of Rodney Brook: "The architecture of the system is loosely based on some ideas called subsumption architecture from MIT."[282] I had the opportunity to question him concerning his position in regard to the two conflicting approaches, the top-down and the bottom-up. In his opinion, the two approaches are possible and co-exist in his work.

> I think human bodies and most biological creatures are both responding to cues from higher drives and directed behaviour (top down) and more bottom up drives and cues (...) I believe bottom up emergent behaviour is how we have evolved and I think the emergence of intelligent robotic forms will be as layered as a human body.[283]

As indicated by these sentences, the artist did not discard the traditional ideas and approach of artificial intelligence research. In his opinion, both approaches are complimentary in the development of emerging behaviours. But if artists like Kenneth Rinaldo believed in the conjunction of traditional artificial intelligence research with the more recent artificial life one, many artists using computers in the nineties embraced the new paradigm and strongly discarded the old one.

---

[280] Kenneth E. Rinaldo, "Technology Recapitulates Phylogeny: Artificial Life Art.", in *Leonardo* 31, no. 5 (1998): 373.
[281] Rinaldo (1998), 375.
[282] Kenneth Rinaldo, e-mail message to author, October 6, 2010.
[283] Kenneth Rinaldo, e-mail message to author, October 6, 2010.

Simon Penny, for example, has taken a very critical stance against artificial intelligence and its related top-down approach. The works of the Australian artist, share many similarities with the robotic experiments carried on by Rodney Brook, for example. His work *Petit Mal*, a project started in 1989, consists of an anthropomorphic robot on wheels, capable of interacting with spectators in gestural, embodied ways, displaying emotional-like features rather then articulated language skills. Penny considers research in artificial intelligence as simply wrong and based upon erroneous assumptions, as the result of an enduring philosophical fallacy regarding the mind-body problem.

> It is through examples such as these that we can see just how clearly so called `objective science' can be heavily value laden, perpetuating dualistic and colonialising ideologies. High tech enterprises, such as Artificial Intelligence and Top-down robotics validate and reinforce these dichotomies with the rhetorical power they derive from being scientific, high tech and futuristic.[284]

In his writings, Penny clearly affirms his opinions about the superiority of the bottom-up approach compared to the top-down one:

> What bearing do ideas of emergent order and techniques of Artificial Life have on interactive art practice, as ideas or tools? The most profound, as I see it, is that it offers an alternative to the current all too deterministic paradigm of interactivity as pre-set responses to user navigation through an ossified database. This paradigm is firmly within the Top-Down camp. Emergent interactive behaviour would not be derived from a set of pre-determined alternatives. Rather, behaviours might arise through a contingent and unconnected chain of triggers.[285]

In these paragraphs, the artist reformulates the paradigm of embodied robotics and the importance of the concept of emergence. Furthermore, the artist openly regards the traditional approach in artificial intelligence as erroneous in its very nature, since, in his opinion, it is based on the dualist assumption that sees human beings as composed by two separate entities, namely the mind and the body. This criticism appears contradictory at first, since the artificial intelligence research is obviously based on materialistic assumptions, which automatically exclude the hypothesis that intelligence is the result of a spiritual substance. In philosophy of mind, materialism is notably opposed to dualism, which commonly assumes the coexistence of material and spiritual

[284] Simon Penny, "The Darwin Machine: Artificial Life and Interactive Art", in *New Formations* (1996): 57.
[285] Ibid., 59.

substances, the latter being responsible for mind and emotional related activities. How can Penny affirm that artificial intelligence research falls into what he considers the dualist mistake? Penny believes that intelligent behaviours, in order to arise, need a holistic approach as prefigured from the bottom-up paradigm. According to his thesis, the top-down strategies, on the contrary, try to independently create intelligent behaviours, that is, without taking into account the body, be it organic or material, in which the mental activities and intelligent behaviours should emerge. Penny can therefore conclude that traditional artificial intelligence research and its peculiar top-down approach, although based on materialist assumptions, truly reiterates the dualist mistake, simply replacing the mind-body dichotomy with another one constituted by the couple matter-information. In a personal interview, Penny eventually questioned the possibility of recreating intelligence in an artificial system, even through a system based on artificial life approaches:

> I fundamentally don't believe in the possibility of intelligence in a computational platform, I am therefore very sceptical about hard a-life theories. In my opinion, the approaches and definition suggested by Maturana and Varela are much more pertinent than that of Tom Ray. The fact is that no a-life can reproduce its own hardware.[286]

Simon Penny spent several years applying the new paradigms of embodied robotics and artificial life in his works, it is interesting to acknowledge that he nevertheless remained sceptical about the factual goals of 'hard a-life', that is to say, the position of researchers who hold the real synthesis of life to be possible. In his opinion, intelligence is situational and grounded in the biological reality of the intelligent organism and the environment in which it evolves and to which it relates. So far, we have only managed to create machines that imitate some very specific aspects of what we consider intelligent actions; because these machines are not independent and self-sufficient, in Penny's opinion they cannot be considered truly intelligent. During the same interview, he stressed the importance of the opportunity for artists to experiment with technologies and ultimately express their poetical visions, rather than attempting to recreate life in artificial systems.

[286] Simon Penny, interview with the author in Barcelona, 6 June 2011.

After the establishment of artificial life and bottom-up approaches, other artists, critics and theorists involved in computer generated art started to embrace the arguments against artificial intelligence. With the same verve, artist and biologist Thomas Ray supported the idea that human intelligence cannot be reproduced artificially, but that digital intelligence might evolve in a way unpredicted by humans.

> We can not expect digital organisms evolving in this way to perform useful work for us, such as guiding robots or interpreting human languages. In order to generate digital organisms that function as useful software, we must guide their evolution through artificial selection, just as humans breed dogs, cattle and rice.[287]

Developed in 1992 by Thomas Ray, *Tierra* is a simulation of an ecosystem of artificial viruses. Although it was originally developed for the purpose of scientific research, the project has been presented and discussed in a large variety of events, exhibitions and publications on media art, to the point that it became an iconic work of artificial life and generative art.

Many other artists expressed their debts to the new paradigm of artificial life. Artist Jane Prophet, for example, explored the use of new technologies in art and discussed topics related to artificial intelligence, artificial life and virtual reality. She expressed her preference for the bottom-up approach when describing one of her most ambitious works, *TechnoSphere*, developed in 1995:

> The notion of self-organising artificial life systems which we have used in TechnoSphere depend on a 'bottom-up' approach, with behaviour emerging as artificial creatures interact, rather than us imposing a 'top down' control on behaviour. This idea of 'bottom up' evolution has been applied to the whole project and carried through to the design process.[288]

Artists Louis-Philippe Demers and Bill Vorn created spectacular and somehow uncanny installations with performing robots. They both acknowledge their debt to artificial life research: "The conceptual framework of our researches is based upon Artificial Life,

---

[287] Thomas S Ray, "An evolutionary approach to synthetic biology: Zen and the art of creating life", in *Artificial Life 1(1/2)* (Cambridge, Mass.: MIT Press, 1994), 195-226.

[288] Jane Prophet, "Sublime Ecologies and Artistic Endeavors: Artificial Life and Interactivity in the Online Project 'Technosphere'", in *Leonardo* 29, no. 5 (1996): 339-344.

immersive environments connectionism, reactivity and artificial behaviors (implanted and emergent)."[289]

In addition to the critical stance toward artificial intelligence moved by artists and critics who embraced the artificial life approach, other artists preferred to adopt the new paradigm to tackle ethical questions, coupled with the possibility of a greater interaction with the spectator. For example, artists Christa Sommerer and Laurent Mignonneau, Professors at the InterfaceCulture Lab, Institute for Media at the University of Art and Design in Linz are commonly associated with artificial life. They have been very active in promoting this approach within artistic research, through their work and their academic activities. Christa Sommerer and Laurent Mignonneau's works present aesthetic qualities and are consciously conceived for artistic venues and exhibition spaces; the artists take great care in the formal qualities of their interactive installations. Many of their works consists of an artificial universe or ecosystem that is graphically represented through a screen, sometimes powered with a tactile device allowing the spectator to interact with the life-like digital creatures evolving in the universe created by the artists. They described their artistic research as investigating the implications of technology for society.

> By using science, namely the principles of artificial life as a source for creation, GENMA is also an attempt to address the question of what it means to manipulate and what impact it will have on us in the future.[290]

This statement appears in the catalogue of the Ars Electronica exhibition in 1996, where the work *GENMA* was presented. On the one hand, Sommerer and Mignonneau rely on the possibilities of creating seemingly living artificial organisms, thus strongly associating their research with artificial life, on the other they affirm their intention to ground their artistic activity in a larger discourse that encompasses ethical questions. The possibility of interaction between the public and the artificial creatures is justified by the intention to further develop a sense of responsibility in the public toward a new form of life. In conclusion, their work was less about paralleling scientific research in

[289] Louis-Philippe Demers and Bill Vorn, "No Man's Land", in Gerfried Stocker and Christine Schöpf, *Memesis: The Future of Evolution* (Wien: Springer, 1996), 263.
[290] Christa Sommerer and Laurent Mignonneau, "Genetic Manipulator", in Gerfried Stocker and Christine Schöpf, *Memesis: The Future of Evolution* (Wien: Springer, 1996), 295.

the development of artificial life forms, but rather to raise and discuss philosophical questions involving the responsibility of the spectator toward artificial living organisms.

> The artist thus takes on a new role, no longer creating autonomous and elevated artworks but radically giving up control over the art itself. The public is responsible for what it sees and the worlds it creates.[291]

Sommerer and Mignonneau are very careful not to defend bold statements about the advances in scientific research; they rather concede that their intention is to generate debate through their work. Their position manifests an awareness of the critical reception of computing technologies within the artistic field. During an interview in Linz in 2011, Christa Sommerer recalled that their early works, presented at the Ars Electronica festival, were harshly criticized by members of the audience precisely because of the association between computing machines and modern technologies, and the defence industry:

> I remember in the beginning of the nineties, many people attacked us, not only us, but many others, because we used computers for creating artworks. They said that computers are just the extension of the military industry. This argument of working with technology as being just a slave of the military industry, I have heard it since I touched a computer.[292]

During the interview, Christa Sommerer additionally states that they were neither interested in the bottom-up versus top-down debate, nor in the serious possibility of generating a truly living artificial being. Artificial life algorithms, coupled with the possibility of interactive media interface and an artistic approach were a means for the artists to eventually stimulate a debate about life and responsibilities. This is the reason why, in some of their works, the audience is called to participate in the creation and survival of artificial life forms.

The concerns expressed by Sommerer and Mignonneau regarding the impact of modern technologies on society reflect a growing tendency in artistic production associated with media art, and a likely explanation as to the preference for artificial life over artificial intelligence. Oliver Grau comes to similar conclusions, when he affirms that "AI failed to deliver the goods of its own predictions, and now, since the end of the 1980s, the

[291] Christa Sommerer and Laurent Mignonneau, "Art as a Living System: Interactive Computer Artworks", in *Leonardo* 32, no. 3 (1999): 173.
[292] Christa Sommerer, interview with the author in Linz, 3 June 2011.

developing area of artificial life has been full of promise."[293] The argument proposed by the media art historian seems to suggest that the reasons behind the failure of artificial intelligence are to be found in the methodology of the research, which unable to achieve its own goals is losing credibility as a result. Consequently, artificial life appears more interesting both for researchers and artists. In this respect, Mitchell Whitelaw has analysed the artistic production associated with artificial life and published an extensive book describing a variety of approaches. He is among the researchers in the media art field who clearly takes a critical position regarding traditional artificial intelligence research. In *Metacreation*, published in 2006, the author demonstrates a profound knowledge not only of the artistic field but also of scientific research and also concludes that artificial life research succeeded where artificial intelligence failed.

> A useful way to briefly provide a sense of a-life's approach and its particular innovations is to examine the way it distinguishes itself from artificial intelligence (AI). It does so frequently, and tends to present itself as succeeding in its aims where AI has failed.[294]

If Whitelaw appears to criticise artificial intelligence and embrace artificial life, thus supporting the epistemological argument proposed by the researchers within the later field, other art historians have rather considered artificial intelligence research from an ethical perspective. Art historian and curator Anne Collins Goodyear, in an article published in 2008, associates the loss of faith in machines with the aftermath of the Vietnam War, thus identifying already in the seventies oppositional tendencies to modern technologies within artistic production:

> With the escalation of the Vietnam War, it became increasingly clear to artists and critics, as explained above, that industrially driven technology was integral to the military campaign waged by the United States against North Vietnam. In such an atmosphere, the destructive associations of technology rapidly replaced the positive connotations that predominated only a few years earlier.[295]

While analysing the reception of the exhibition "Art and Technology" at the Los Angeles County Museum of Art in 1971, the art historian signals that many critics and

[293] Oliver Grau, *Virtual Art: From Illusion to Immersion* (Cambridge, Mass : MIT, 2003), 315.
[294] Mitchell Whitelaw, *Metacreation: Art and Artificial Life* (Cambridge: The MIT Press, 2006), 7-8.
[295] Anne C. Goodyear, "From Technophilia to Technophobia: the Impact of the Vietnam War on the Reception of 'Art and Technology'", in *Leonardo* 41, no.2 (2008): 172.

artists started to manifest dissent concerning the relationship between art and technology.

But the association of technology with the defence industry is only a part of the discourse developed by new media artists and critics in regard to the impact of technologies. When it comes to the growing presence of computers in everyday life, some artists have raised issues in relation to the emerging digital culture. Mary Flanagan, an artist who has frequently dealt with artificial reality, published several articles addressing the subject in a critical way. In her essays, she advocates for more awareness and open discussion around virtual reality and virtually constructed agents. She urges for the adoption of a moral and critical position towards computing machines and digital technologies in order to question the implications of artificial reality and artificial agents on the lives of individuals and society as a whole. Her critique also considers the question of gender specifically in relation to the formation of social relationships established in an uncontrolled context such as the internet and virtual reality.[296]

Similarly, Katherine Hayles, a writer and cultural theorist deeply interested in the impact of technologies on society in general and the constitution of individual identities in particular, recognises the unwelcome association of technology with dominance and over-power.

> If my nightmare is a culture inhabited by posthumans who regard their bodies as fashion accessories rather than the ground of being, my dream is a version of the posthuman that embraces the possibilities of information technologies without being seduced by fantasies of unlimited power and disembodied immortality.[297]

Katherine Hayles, alongside Donna Haraway and her famous Cyborg Manifest,[298] belongs to a group of critical theorists that have considered the emergence of a post-

[296] See, for example: Mary Flanagan, "The Bride Stripped Bare To Her Data: Information Flow + Digibodies", in Robert Mitchell and Phillip Thurtle, *Data Made Flesh: Embodying Information* (New York: Routledge, 2004).

[297] Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago, Ill: University of Chicago Press, 1999), 5.

[298] Donna Haraway, "A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century," in *Simians, Cyborgs and Women: The Reinvention of Nature* (New York; Routledge, 1991).

human society as a way of overcoming gender diversity. While Hayles and Haraway not only examine the dangers of cybernetic research and the development of a post-human society but also the positive outcomes, other critical theorists don't share the same optimism. Art historian and philosopher Barbara Becker, in an essay published in 2000, analyses the developments of digital technologies to take into account theories of trans-humanism and post-humanism associated with the most radical artificial intelligence researchers, such as Ray Kurzweil and Hans Moravec. In her opinion, many research projects in this field are based on a misconception of our human existence and its peculiar material reality: "There are strange visionaries who dream about a posthuman evolution. Thinkers like Moravec, More, and others hope to combine human minds with technical artefacts to eliminate the fragility and mortality of the human body."[299] Becker concludes that these visions of the humanity have a negative impact on society because they tend to strengthen selfish and reclusive behaviours.

> The dissonance and noise of the material world, which cannot be reduced to a discursive construction, and the thrilling strangeness of the other are both successively obliterated in favor of a solipsistic turning to an inner world, accompanied by the illusion of control. In different forms, we find this in visions of technological self-design, bodiless self-construction, and virtual self-creation.[300]

Artists and historians such as Anne Collins Goodyear, Mary Flanagan, Katherine Hayles and Barbara Becker represent a strong critical position toward modern technologies, artificial intelligence and computing machines within the artistic field. Their arguments warn against the alienating dangers intrinsically to the implementation of computing machines within our society, as well as its association with capitalism and technological warfare. However, other art critics point out that the association of modern technology with military funding and capitalism should not be carried over to artistic production. Among the most notable media art theorists, Geert Lovink emphasised the independence of artists, working with computers and new medias, from information technology industries and military research.

> It is only outsiders who can accuse the electronic arts of compliance with the 'capitalist system'. The sad reality is that artists aren't all that different from ordinary computer users, unless they are part of the celebrity high-end circuit.

[299] Barbara Becker, "Cyborgs, Agents, and Transhumanists", in *Leonardo* 33, no.5 (2000): 362.
[300] Becker (2000), 365.

> For the majority of artists access to technology is limited to consumer electronics. Often there is no money for more state of the art machines and software. Industries already have their own networks who do the demo design. This is the true tragedy of new media arts. Those who turn new media inside out and develop an aesthetic agenda have no place in today's production processes.[301]

What is interesting to note in this paragraph, is that Lovink recognises how among uninformed critics, the association of artistic production involved with new technologies and computers to the 'capitalist system' has become a fact. In Lovink's opinion, artists that use new media in their work are unjustly criticised by curators and critics who are not involved in this specific artistic production. According to him, it is only a handful of artists that can benefit from collaboration and significant support from the industries producing these medias. According to the critical theorist, the choice to work with a specific medium and the content of the work produced by the majority of media artists cannot therefore be dictated by commercial imperatives.

The association between the research in artificial intelligence, private corporations and the defence industry has been recognised and discussed by Andrew Pickering in a recent essay on cybernetics, in which he is a respected authority. In his comprehensive history of cybernetics, he admits that the research has involved and subsequently been compromised by military funding. Nevertheless, the historian feels compelled to add that:

> In our world, any form of knowledge and practice that looks remotely useful is liable to be taken up by the military and capital for their own ends, but by the end of this book it should be abundantly clear that military and industrial applications come nowhere close to exhausting the range of cybernetics.[302]

The author suggests that the association of cybernetic research with the defence industry should not be exaggerated. By way of contrast, he provides several examples of cybernetic research that has developed independently and on many occasions even in amateurish fashion. Nevertheless, the considerations by Geert Lovink and Andrew Pickering, and their responses to the link between cybernetics and the defence industry

---

[301] Geert Lovink, "New Media, Art and Science: Explorations beyond the Official Discourse", in Scott McQuire and Nikos Papastergiadis, *Empires, Ruins + Networks: The Transcultural Agenda in Art* (London: Rivers Oram Publishers, 2005).

[302] Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2010), 15.

and capitalism, are evidence that today this association is deeply implemented in collective representations of these fields of research.

3.5 Epistemological and Ethical Arguments

The arguments brought against modern technologies and more specifically artificial intelligence can be distinguished between epistemological arguments questioning the scientific goals and their approaches, and ethical arguments addressing the consequences and the impact of the research on the society. Parallel to the voices raised within the scientific community and the humanities, artists involved in media art have been discussing the same questions in critical terms. If ethical concerns have been raised by artists regarding the involvement of digital technologies in our society, it seems that the epistemological discourse, on the other hand, has been particularly influential within the cluster of artists that were more deeply involved with computer and generative art. The emergence of artificial life and embodied robotics in the eighties seem to have encouraged new approaches in the use of computers in art. Furthermore, the arguments advanced against artificial intelligence by these disciplines recurs in the writings of some of the most significant artists and critics of media art involved in generative approaches after the eighties, such as Simon Penny and Mitchell Whitelaw, who have been prolific in discussing bottom-up approaches in the arts.

The debate about the use of computing machines in art was favoured by publications and institutions dedicated to arts and technologies. International events and journals focusing on media art such as the Ars Electronica Festival and the *Leonardo* journal functioned as important platforms for the discussion and confrontation of ideas between artists, critics and researchers. An analysis of the *Leonardo* journal, from the first issue published in 1968 to 2004, provides a telling insight into the interest in topics related to artificial intelligence and artificial life. Close analysis of articles dealing with these topics down through the years reveals a consistency of articles on artificial intelligence from 1969 to 1991, with a total of twenty-four articles during that period of time. A first article on artificial life appears in 1988 and a second in 1993. From 1993 to 2004, a total

of thirty-four articles on artificial life are published while only 10 are dedicated to artificial intelligence in the same period. If we consider the *Leonardo* journal as a barometer with which to gauge artistic production in the field of new media art, these numbers suggest a shift in interest from artificial intelligence to artificial life during the nineties.

Another relevant indicator, the Ars Electronica Festival is an internationally recognized event dedicated to art and technology. Every year it hosts a series of exhibitions, conferences and awards. Since its first edition in 1979, it has provided an important platform for artist, critics and researchers to meet and share their work. Since 1987, each edition of the festival has focused on a specific topic related to technology, the arts and society. It is interesting to consider the presence of researchers and their participation in the symposiums organized within the Festival. Over the years, the most famous researchers associated with artificial intelligence, robotics and artificial life have been invited to participate in conferences and podium discussions. Among them are personalities such as Marvin Minsky, Hans Moravec, Pamela McCorduck, Rodney Brooks, Christopher Langton and Luc Steels, to name a few. The articles on artificial intelligence and artificial life in *Leonardo* and the participation of researchers at the Ars Electronica festival suggest that the scientific debate opposing artificial intelligence and artificial art has fuelled the artistic activity and has significantly shaped the evolution of artistic production within computer and generative art.

Having considered the positions of the artists that discussed the opposition between bottom-up and top-down approaches, it seems that the majority of artists involved in computer-based generative art after the eighties were all very favourable to embracing the new bottom-up approach, while I hardly found any artist willing to advocate for the top-down approach. Moreover, the researchers in the artificial life field, where the bottom-up approach was established, were largely mentioned and discussed among the artists, while the texts of theorists of the classical top-down approach were practically ignored in the essays of artists, critics and historians. Why did the bottom-up approach, put forward by embodied robotic and artificial life, have greater success and impact on the artistic production? Some hypothesis can be suggested from the positions of the

artists and the evolution of the topics in the Ars Electronica festival and the *Leonardo* journal. The ideas and works of the new scientific fields were possibly more inspiring and convincing for a new generation of artists. Furthermore, the artists were eager to participate in a new genre that manifestly aroused interest in the media art field. The necessity to present newer work related to the most 'trendy' disciplines is quite understandably an imperative in a field that seeks to connect art and technology. Another reason could be linked to the exaggeratedly optimistic and confident attitude of some researchers and institutions in the artificial intelligence field itself, where the announcement of upcoming innovations and spectacular achievements - that would never be fulfilled - was a regular feature. These promises may have undermined the credibility of artificial intelligence in the eyes of artists. Conversely, artificial life research and embodied robotics did not engage in audacious predictions, precisely because it was founded in an approach that would expect the properties to emerge from the system itself. The researchers in these new fields, therefore, were not necessarily obliged to predict exactly which property they were expecting and in which timeframe: rather they focused on the concept of emergence and on the evolutionary possibilities offered by the system. In my opinion, it is for this reason that the concept of emergence had such a significant impact on artistic production, a concept that allowed for much more freedom and outcomes in a creative context. It is also very rare to find references to seminal texts by known researchers associated with traditional artificial intelligence research, even in the writings of artists engaging with it, while the texts of Christopher Langton and Rodney Brooks, representative of the new paradigm, are very often mentioned in the writings of artists engaging with computer generated art of the nineties.

On the other hand, epistemological concerns and the fascination for new fields of research were probably not the only reasons that artists were encouraged to dissociate themselves with artificial intelligence research. Questions of aesthetic, formal qualities and the reception of the works were also involved. In his extensive research about modern sculpture, Jack Burnham considered the impact and significance of technological progress in art. He believed that new tendencies in sculpture producing what he called 'systems' were the result of a profound transformation of society. In his

comprehensive survey of contemporary sculpture, published in 1968, he already anticipated the importance that computer programming and new technologies would have on artistic production, predicting the emergence of an aesthetic of artificial intelligence in art. The author further envisaged two future approaches to technology: "Sculpture can choose one of two courses: it can be fashioned as a reaction against technology or as an extension of technical methodology."[303]

Jack Burnham was right in predicting the development of artistic research associated with computers and artificial intelligence. He also correctly predicted the necessity and the emergence of an aesthetic discourse associated with this field. Indeed, questions regarding the formal qualities of the works and their reception were also debated between the artists, curators and critics involved with computer technologies. Computational linguistics Professor and composer Remko Scha, for example, regarded the works of art produced with new media and computer programming as being the successors of Dadaist traditions. He affirms that computer-based art further develops dada-like strategies exploiting automatic creation, in order to represent the diversity and unpredictability of nature and reality, following the Kantian idea that nature is superior to artifice. But not all the critics and historians appreciated the works created with computers. In a provocative article that appeared in *Leonardo* in 1989, artist Brian Reffin Smith manifested his dissatisfaction with a large body of computer art. He sustained that "in general, computer art is the most conservative, dull, un-innovative artform of the 1980s."[304] This harsh criticism doesn't come from a theorist uninformed about the artistic production involved with new technologies. Brian Reffin Smith has been deeply involved with computer art and often defended this kind of artistic production, affirming its artistic validity. Nonetheless, the author concedes that many works produced in this field are mediocre and aesthetically uninteresting. In affirming the dull and un-innovative character of the majority of artworks created with computers, de facto he invites artists engaged in this production to show more creativity and audacity. The considerations put forward by Brian Reffin Smith are representative of a larger critical reception of works associated with new technologies. If an artist such as

[303] Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (New York: G. Braziller, 1968), 376.
[304] Brian R. Smith, "Beyond Computer Art", in *Leonardo* Supplemental Issue 2 (1989): 39-41.

Brian Reffin Smith, who has a profound knowledge of this kind of artistic production, expresses his dissatisfaction with a large part of it on a formal, artistic level, we might understand why this specific production has found it difficult to succeed in the larger community of visual arts. Artists have always been sensible concerning the reception of their works. As an example, Kenneth Feingold, as already mentioned, clearly expressed his dissatisfaction with his former research by taking into account the reaction of the public.

Another important factor certainly played a role in facilitating the shift from top-down to bottom-up strategies: the association of artificial intelligence with capitalism and the defence industry put forward by many philosophers and researchers. In this respect, Geert Lovink makes an important point, when he advocates for media art and affirms that it is mainly misunderstood and wrongly associated with capitalism. "The corporate world is not interested in the new media artworks because in the end they are too abstract and seriously lack sex appeal. Do not make this mistake. New media art is not merely a servant to corporate interests."[305] What Geert Lovink suggests, is that new media art is often disregarded by the majority of art critics not only because it lacks aesthetic qualities, compared to traditional media, but also because of the wrongly assumed idea that it is compromised by the information technology industry. The statement is interesting because, while rejecting the association of media art with the corporate world, it also stresses how this association persists in the cultural field. Under such conditions, it might be understandable that artists working with computers and generative approaches felt compelled to justify their work as being artistic, thus dissociating it from artificial intelligence research that was inevitably linked to the defence industry and to capitalism. The attacks by critical theorists and researchers against artificial intelligence contributed to the undermining of the theoretical background associated with the top-down paradigm, thereby encouraging the shift of interest towards artificial life and bottom-up strategies.

[305] Geert Lovink, "New Media, Art and Science: Explorations beyond the Official Discourse", in Scott McQuire and Nikos Papastergiadis, *Empires, Ruins + Networks: The Transcultural Agenda in Art* (London: Rivers Oram Publishers, 2005).

From the analysis of the positions of the artists working with computer and generative approaches, we can conclude that attacks on artificial intelligence have had an impact on their artistic practices. Artificial intelligence has been accused of being founded on an erroneous basis and of being incapable of achieving its epistemological goals. As a consequence, many artists praised the merits of artificial life research in opposition to artificial intelligence. More particularly, some artists raised ethical questions regarding the massive implementation of computer technologies, artificial intelligence and artificial reality. They argued that it should be the role of artists to question the moral consequences of the implementation of such technologies in our society. Finally, some artists and critics expressed dissatisfaction concerning the formal qualities of the works and their reception, in particular those works involving computer technologies. It is probably not a coincidence that, while artificial life research surfaced as an alternative to the traditional artificial intelligence research in the eighties, many artists working in the fields of computer and generative art were keen to embrace the newest trend. It is also relevant to note that they not only embraced the new approach but they also actively engaged in the theoretical discussion, further polarising the opposition between the traditional top-down and the new bottom-up paradigm.

The question concerning the implementation of modern technologies within our society has raised a significant debate among philosophers, researchers and artists. Ethical and epistemological arguments against artificial intelligence research have been discussed not only within the scientific field, but also in the arts. In conclusion, we can affirm that the artistic production in this field has been particularly shaped by the debate opposing the traditional top-down approach and subsequently embracing the bottom-up approach. In addition, the association of the computing machine with capitalism and the defence industry has also been echoed in the community responsible for the dissemination of artistic productions associated with computer and generative art. Indeed, faith in the computing machine and its associated research, artificial intelligence, did not last long. If in the pioneering years computers were considered as an opportunity for epistemological research, in the following years some artists began to move in an opposite direction, possibly preluding more overtly oppositional tendencies.

Chapter 4

4.1 Computer Art at the documenta X Exhibition

The implementation of the computing machine in society was not without controversy, as discussed in the previous chapter. Nevertheless, its use in the artistic field seemed to progress and raise interest within a larger artistic community, as indicated by the development of festivals and journals dedicated to digital and media art such as Ars Electronica and *Leonardo*. What about the traditional field of art and its circuit? In 1997, the documenta exhibition in Kassel finally hosted a showroom dedicated to computer art, focusing in particular on works exploiting the Internet.

Expectations were high regarding the last documenta of the millennium, directed by the French historian and curator Catherine David. Before the opening, rumours circulated that the important international exhibition in Kassel would be a technological one. Catherine David dismissed these rumours and stated that the exhibition would focus foremost on ideas and content, rather than media.[306] On the other hand, documenta X featured for the first time a website, which besides providing general information on the event, would also host works of computer art conceived to be experienced online. Swiss curator Simon Lamunière was commissioned to design and curate the website, in collaboration with Catherine David, as well as the showroom dedicated to these works in the documenta-Halle during the exhibition. Joan Heemskerk and Dirk Paesmans, also known as Jodi, were among the artists invited to participate in the website and exhibition.

The creation of a website and presentation of works of computer art, more particularly net art, at documenta X is an important moment in the history of media art. During these years, media art emerged as a distinct field within contemporary art, constituting a

[306] In the press release distributed on March 21, 1997, Catherine David affirms: "I would clearly like to refuse that unexplainably popular opinion that it will be an exhibition full of monitors and computer terminals." (documenta Archive Kassel: d10, Mappe 275).

cluster of artists, critics and curators providing a specific theoretical framework and a vocabulary for it. It was a chance for artists working with computers to present their work in an internationally significant venue such as documenta, and therefore an opportunity to gain visibility and recognition among the more traditional and prestigious contemporary art world. For this reason, expectations were high not only for the public but particularly for the emerging media art scene. The event went through some turbulence and the presentation of works of media art at documenta was not performed without difficulties and conflicts. The analysis of the presence of media art at documenta X, in particular focusing on the participation of Jodi, provides important insight into the evolution of computer-generated art, on the one hand, and the dialogue between digital art and traditional art on the other. It also provides some different perspectives with regard to the integration of media art works in traditional art museums and institutions, offering alternative answers to questions that are currently being discussed by critics and curators engaged in media art.[307]

How did computer and media art enter the door of an important international event such as documenta, in 1997? Which choices were made in the selection of the artists and in the presentation of their works? To what extend were they integrated in the main exhibition and in the general concept of the event? What were the reactions of the professional press to these works and their presentation? Conclusively, what has been the significance of this event concerning the career of the artists? I have approached these questions by analysing, more specifically, the case of the artist duo Jodi.

4.2 Which Criteria for Media Art?

A proposal document in the documenta archives in Kassel, shows that the creation of a website for the event was already considered in the early stage of the planning for the exhibition. The website was originally imagined as a simple information tool for the

[307] For an example of discussions relating to media art in Switzerland, see: Anke Hoffmann, and Andreas Broeckmann, *Connect. Kunst zwischen Medien und Wirklichkeit: eine ausstellung mit Medienkunstarbeiten des Sitemapping-Programmes (BAK) 2003-2011, Shedhalle Zürich 14. Juli-11. September 2011] = Connect. Art between Media and Reality* (Nürnberg: Verlag für moderne Kunst, 2011).

event and director Catherine David initially considered turning to local company - Media Highway & Cross Culture, specialised in information technologies - to create the website.[308] It is only with the commission of the event to the Swiss artist and curator Simon Lamunière that the website took its definitive form, integrating on the same platform useful information for visitors, together with the artist's work created for the web. At that time, Simon Lamunière was in charge of *Version*, a biennial exhibition focusing on computer and digital art at the Centre pour l'Image Contemporaine in Geneva, directed by André Iten.[309] Catherine David visited the second edition of the biennial, *Version 2.2*, in 1996 and, according to the Swiss curator, it is during that event that she discovered another approach to computer art, a more creative one compared to other approaches which tended to be determined by a fascination for computer technologies.[310]

The curatorial approach of Simon Lamunière at the Centre pour l'Image Contemporaine must have convinced Catherine David, because the Swiss curator was eventually commissioned to develop and design the website on which he actively began working in August 1996. With the direction of Lamunière, the website became not merely an information tool for documenta, as was initially intended, but also a space to present works of art created for that medium. The use of computers to create works to be experienced and shared through the Internet, constituted a growing community of artists that would be grouped under the term internet art, net art or net.art, during the second half of the nineties. The choice to assign the curatorial care of the documenta X website to Lamunière was a decisive one. The Swiss curator imagined a website that would merge both the practical visitor information and the artistic works within the same platform, dividing the sections dedicated to the works into four thematic groups, where other documents and links were also available. The four groups were entitled: *Surfaces & Territories*, *Cities & Networks*, *Groups & Interpretation* and *In & Out*.

---

[308] Media Highway & Cross Culture, "DOCUMENTA '97 - ONLINE", 30.11.1995 (documenta Archive Kassel: d10, Mappe 275).

[309] The website describes the festival as "la biennale informatique du Centre pour l'image contemporaine", http://www.centreimage.ch/version.php (accessed: 22 January 2013).

[310] Simon Lamunière, interview with the author in Geneva, 7 January 2013.

The first group, *Surfaces & Territories*, included the work *A Description of the Equator and Some Other Lands* (1997), by Philip Pocock, Florian Wenz, Udo Noll and Felix Stephan Huber, a collaborative and interactive online script for a hypothetical movie, or 'hypermovie'.[311] The first group also included the works *Without addresses* (1997) by Joachim Blank & Karl Heinz Jeron, an interactive generative map created by the registrations of the visitors to the web, and *Location Sculpture System* (1989-97) by Eva Wohlgemuth and Andreas Baumann, an online documentation of their series of works *System*, consisting of interventions in the territory evoking mental associations. Holger Friese's *unendlich, fast...* (1995) a poetic work displaying a very large, blue window to be scrolled from side to side and up and down was also presented in the first group. In a remote area of the blue window, a group of ACSII characters recalled a constellation lost in a blue sky. Simon Lamunière explained that the characters consisted of the encoded version of the mathematical symbol of the infinite.[312] Lastly, the first group included the work *jodi.org* (1994-1997) by Joan Heemskerk and Dirk Paesmans. According to the description provided in the *documenta X: short guide*, the work consisted of an active link to the website of the artists which, at that time, consisted of approximately 350 pages that were constantly updated.[313]

The second group, *Cities & Networks*, presented the work *Up to 625* (1997) by Matt Mullican, a corpus of hundreds of images which the user could navigate as a hypertext, and the work *Visitors Guide to London* (1994-5) by Heath Bunting, an interactive visit to London reproduced through a collection of low resolution black and white images. The second group also included an online reference to the work *Metro-Net* (1997), an installation created by Martin Kippenberger and displayed in the Karls-Aue park during documenta.

The third group, *Groups & Interpretation*, comprised the work *On Translation: The Internet Project* (1997) by Antoni Muntadas, an online version of his work investigating the process of translation, exploiting the possibility to send a sentence worldwide and

[311] Catherine David and Paul Sztulman, *documenta X: short guide = Kurzführer* (Ostfildern-Ruit: Cantz, 1997), 107.
[312] Simon Lamunière, interview with the author in Geneva, 7 January 2013.
[313] Catherine David and Paul Sztulman, *documenta X: short guide = Kurzführer* (Ostfildern-Ruit: Cantz, 1997), 110.

follow the modification of its meaning through the successive conversion into different languages. The group also presented a reference to *Beware*! (1995-97), a selection of movies focusing on the role of the spectator conceived by Johan Grimonprez and Herman Asselberghs.

Finally, the fourth group, *In & Out*, presented the works *l.o.s.t.* (1997) by Hervé Graumann, a sequence of navigable texts highlighted by a beam of light, an online reference to the work *suspension* (1997) by Jordan Crandall & Marek Walczak, and an online reference to the work *Makrolab* (1997) by Marko Peljhan.

The selection of artists for the website was made by Simon Lamunière, who was convinced that computer art is not about technology, but about art. For Lamunière, the value of a computer artwork lay in the creative use of technology rather than simply using computers as a processing machine. In the booklet of the CD-ROM, produced for documenta as a software documentation of the website, Simon Lamunière wrote: "I have no intention of talking about the Net or cyberculture in general; much closer to home, on the other hand, are the concrete works of art."[314] He also decided to invite artists that belonged to the emerging community of internet art, such as Heath Bunting and Jodi, together with artists coming from the more traditional contemporary art field, who were invited to create a specific work for the website without having necessarily had much experience with that technology, such as Matt Mullican. By doing so, he ensured that the website project would present a selection of the important actors from the new internet art scene, but it would also allow him to venture into a more creative curatorial experiment with artists that he considered capable of providing interesting topics and approaches.

However, these choices only partially explain the selection of the artists for the website project, in particular concerning the artists familiar with this specific medium. The artists using computers and the Internet represented a growing community and substantial literature on their work was lacking: consequently, it was a difficult decision to choose among them. What were, from a curatorial point of view, Simon Lamunière's

[314] Simon Lamunière, *documenta X www.documenta.de : documenta 10 Website,* (Kassel: documenta und Museum Fridericianum, 1997), CD-ROM.

criteria for selecting the artists? The determination to create a combination of artists from the traditional contemporary art field together with the computer art field leaves the question unresolved, and so does the decision to invite artists privileging a creative use of technology, a criterion that could be interpreted in very dissimilar ways. A first project submitted in the early 1997 to Catherine David by Lamunière, mentions that the website will be thematically centred on the concept of geographies: "Geographies is a working title synthesising different aspects ranging from the computer screen and its limits, to the world and perception."[315] What is interesting, apart from the concept of geography, is the concept of limit mentioned in the first project by the Swiss curator. During a personal interview, Lamunière confirmed to me that the concept of limit was important in both his artistic and in his curatorial work. "I have been constantly interested in limits. I always affirm that I am a 'fire exit curator': I was born on the crossroad of limits."[316] The importance of the concept of limit is more explicitly stated in the texts presenting the artists selected for the website project in the short guide. Lamunière wrote all the texts for the works that he was responsible for. It appears clear that in many texts, the artist's works are described in terms of their inclination to play with the limit of the machine. Regarding the work of Holger Friese, Lamunière writes that: "On one hand he attempts to push the machine and its computing power to the limits, and on the other to bring out its inherent formal contingencies."[317] On Hervé Graumann, he writes that he "situates his work on that abstract, blurry boundary between author and machine."[318] The work of Antoni Muntadas is described as using "deconstructive strategies to reveal the symbolic and political meanings behind agencies and structures like the media (...)" and, more specifically, his work for the website project "continues to explore what is at stake in transcription, interpretation, and translation, from language to code, from science to technology, from subjectivity to objectivity."[319] Concerning Heath Bunting, Lamunière affirms that "when he uses networks or some other leading-edge technology, it is less to work on their behalf than

[315] Simon Lamunière, "Letter to Catherine David - Geographies, 10 artist projects for the documenta X website", 10.1.1997 (documenta Archive Kassel: D10, Mappe275).
[316] "C'est quelque chose qui m'interesse toujours, les limites, toujours. Moi je dis toujours que je suis un 'Fire Exit Curator'. Je suis né aux chemins des limites" Simon Lamunière, interview with the author in Geneva, 7 January 2013, my translation from the French.
[317] Simon Lamunière in: Catherine David and Paul Sztulman, *documenta X: short guide = Kurzführer* (Ostfildern-Ruit: Cantz, 1997), 66.
[318] Ibid., 76.
[319] Ibid., 164.

to turn them to other ends by perverting them in some way."[320] Finally, of Jodi, the curator states that: "The question of how to take over the machine, along with interest in viruses and the disturbances and dysfunctions they cause in computer systems, have been constant elements in Jodi's work."[321]

To push the machine to the limits, to question the blurry boundaries between the user and the machine, to deconstruct and reveal the functioning of a medium, to take over the machine and pervert it: these are the elements that have been highlighted as the creative aspects of the works selected for the documenta's website project. We can deduce that these characteristics were quite probably the fundamental elements behind the curatorial choices in the selection of the works. These choices matched the expressed interest of Lamunière for the concept of limit, together with his frequently asserted position that he is interested in art and not in technology per se.

The curating of the website, in addition, was undertaken with the supervision and collaboration of documenta's artistic director. Catherine David made it clear that she was rather interested in visions, more than aesthetic questions. As a consequence, documenta X was quickly perceived as a political event, while the artistic director was ineluctably described as "a French curator well-steeped in postmodern critical theory."[322] David did not attempt to dismiss these assumptions. During a long interview for *Art Press*, she affirmed that: "In this documenta, we have favoured critical artists who operate on another level, namely artists who engaged in a constant questioning of the anthropological foundations of culture."[323] This sentence summarises quite clearly the general curatorial approach of Catherine David for documenta, an approach that is inevitably mirrored with the one adopted for the artistic contributions to the website. During the press conference presenting the website project, she affirmed that:

---

320 Ibid., 38.

321 Ibid., 110.

322 Ken Johnson, "A post-Retinal documenta" in *Art in America*, October (1997) (documenta Archive Kassel: D10, Mappe41), 81.

323 "On a privilégié dans cette documenta des artistes critiques opérant à un autre niveau, à savoir des artistes qui se sont livrés à un questionnement toujours à l'oeuvre des fondements anthropologiques de la culture" Catherine David, "documenta 10: priorité au débat d'idées - interview de Catherine David par Catherine Francblin et Jean-Yves Jouannais", in *art press* n.225 (1997) (documenta Archive Kassel: D10, Mappe42), 41, my translation from the French.

> New technologies are nothing other than new means to an end. Alone they are of no significance; it always depends upon how they are applied. I am against naive faith in progress, glorification of the possibilities of technological developments. Much of what today's artists produce with New Media is very boring. But I am just as opposed to the denunciation of technology.[324]

For David, consequently, works of new media art are not interesting per se, a typical position, although her description of the majority of media art works as being 'very boring' is certainly noteworthy. Furthermore, David considered that new technologies are only a means to an end, tools that don't differ from more traditional ones for an artist to operate his or her critical questioning of the 'anthropological foundations of culture'. David's vision does indeed correspond to Simon Lamunière's curatorial vision for the website. Both curators shared the conviction that works of media art that were worthy of being presented not only dealt with formal exercises about the nature of the medium, but rather offered a critical perspective on it.

4.3 Jodi, a Bomb in the Source Code

While Simon Lamunière and Catherine David were collaborating on the development of the website project for documenta X, between 1996 and 1997, Jodi was gaining considerable attention within the emerging media art scene. Through the website *irrational.org* and the *Nettime* mailing list, artists such as Heath Bunting, Alexei Shulgin and Vuk Ćosić started to exchange works and ideas on the creative and critical use of the internet. Jodi is an art collective composed of Dirk Paesmans (*1965, Brussels) and Joan Heemskerk (*1968, Kaatsheuvel). Today, Jodi are considered among the most successful and influential artists associated with net art, but their work is often presented in more general publications on media art and computer art.

In 1993, Dirk Paesmans and Joan Heemskerk were hosted at the San Jose State University for an artist in residence program, where they had the opportunity to experiment with computer languages and web programming. They eventually created a website, which they have continued to develop ever since: wwwwwwwww.jodi.org.[325]

[324] Catherine David, "Statement", March 21 1997 (documenta Archive Kassel: d10, Mappe 275).
[325] The information concerning Jodi's residency is reported in an interview with Tilman Baumgartel in:

Instead of creating a virtual platform to display reproductions of physical works, Jodi conceived a website that functioned as a work in its own, a work that they kept transforming and evolving throughout the years. The website consists of a collection of pages that became distinctive of Jodi's aesthetic, exploiting colourful characters, graphical glitches and overlapping images in chaotic compositions that often recall the frozen screens of virus infected computers. The artists frequently play with the possibilities offered by HTML and the interactive opportunities allowed by the Internet, the content of their website being often fed by other websites' content and inputs provided by visitors. Among the first online work created by Jodi is a black page filled with an apparently illogical sequence of bright green ASCII characters, mostly dots and slashes. The sequence of characters completely fills the screen from side to side and from top to bottom. To understand the work, one had to go beyond the surface of the screen and display the source code of the page, a feature that is provided by the browser in the menu, or by clicking the appropriate combination of keys on the keyboard. The source code of the web page is the written instruction of the page, following a specific syntax that organises the final output and functionality of the page. The exploration of the source code of any given webpage would provide an informed user of the organization of the page and the instruction that operates it. To any other visitor, the source code would appear as a sequence of instructions in a markup language, usually HTML. Not in the case of this specific work by Jodi: in opening the source code, the work fully reveals itself to the visitor. In fact, the artist has written the source code - rather, they have drawn it with ASCII characters - without any concern for the result that it would generate. They did not intend to use the code as a functional tool to instruct the website. Instead, they used the space of the source code as a blank page to reproduce the schematics of the nuclear bomb and the nuclear chain reaction, using characters such as numbers, punctuation marks, lines, and parenthesis in the tradition of ASCII art. The resulting webpage with the long sequences of green characters is simply the source code as rendered by the browser.

This early work reveals Jodi's intention to invert the usual functioning and experience of the Internet and computing machine, by hiding the work where it is not expected. It

---

Tilman Baumgärtel, *Net.art 2.0: neue Materialien zur Netzkunst* (Nürnberg: Verl. für Moderne Kunst, 2001).

also shows how the artists subvert the technology to their own ends: instead of complying with the language of the machine, they use it as a creative space. Furthermore, they invite the user to go beyond their habitual experience of the Internet and, to look behind the surface. It is quite suggestive that the image discovered in the source code represents the plans of a nuclear bomb, possibly an allusion to the military research that underlies the development of information technologies. As is well known, the origin of the Internet, before the invention of the World Wide Web protocol and its development for a wider public at CERN, was tightly connected to the U.S. Department of Defense. On the other hand, the work by Jodi could be considered a work of generative art: the artists have used a procedural system – composed of a computer, programming languages and the software that operates it – to create a work that in its final output is unpredictable and dependent on the contingency of the system itself, apart from the source. These aspects of their work satisfy the generally accepted definition of generative art.[326] It is not a surprise that the generative properties of many works created by Jodi have been pointed out, for example by Florian Cramer,[327] although their pioneering position as internet artists has been preferred in the discussion of their work. What has not been pointed out, to my knowledge, is that the generative character of their work does contribute to the general purpose and discourse of the artists, aiming at deconstructing the aesthetic of the computer and information technologies, on the one hand, and at emphasising the growing dependency on these technologies on the other.

Without hesitation, the two artists affirmed: "from the very beginning on, it has been the most important task for JODI to do everything wrong on the Internet that can be done wrong. That's the core of all our work."[328] The first website created by the artists, with its glitches, errors and chaotic display of texts and images that have now become their distinctive aesthetic, is indeed the result of a compulsion to do 'everything wrong', to play with and deconstruct the syntactical elements of the machine and its code in order

[326] See, for example, the commonly accepted definition by Galanter: Philip Galanter, "What is Generative Art? Complexity theory as a context for art theory" in *Proceedings of Generative Art Conference GA2003* (Milan: Generative Design Lab, Milan Polytechnic, 2003).

[327] Florian Cramer, "DISCORDIA CONCORS: www.jodi.org", in *Install.exe - Jodi: [plug in] Kunst und neue Medien, Basel, 18. September bis 27. Oktober 2002* (Basel: Merian, 2002).

[328] Dirk Paesmans, in: Tilman Baumgärtel, *Net.art 2.0: neue Materialien zur Netzkunst* (Nürnberg: Verl. für Moderne Kunst, 2001), 167.

to fight against it. The artists carried on the same approach coherently in their subsequent works, applying similar strategies to web browsers (*OSS/*, 1998; *404.jodi.org*, 1998; *Wrong Browser*, 2001), computer games (*untitled game*, 1996-2001; *sod.jodi.org*, 1999; *maxpaynecheatsonly*, 2006) and social networks (*folksomy.net*, 2008; *g33.con*, 2009; *thumbing.org*, 2010).

The reasons behind this determination to subvert the seemingly logical functioning of the computer are explicitly stated by the artists in an interview with Tilman Baumgaertel: "we do these things because we are angry. The people at the other computer terminal feel this rage." Questioned about the grounds of their anger, they reply: "Because of the prominence of technology. It is obvious that our work turns against High Tech. We also fight against the computer on a graphical level."[329] From these paragraphs, it appears clear that the artists are not motivated by a fascination for the technologies that they decided to work with, but rather by anger and frustration concerning their overwhelming importance in our everyday life. It is interesting to note that their action against the technology is not only performed on a conceptual level but is sustained by the formal approach of the artists against the graphical norms of computers and the popular, commercial applications that dominate their use.

The fight that the artists are undertaking against the machine has to be experienced in a particular context: their work needs to be experienced individually, with a personal computer. Although the artists have been invited to participate in solo and group exhibitions in many international institutions, they consider that their works are best experienced at home. In the first interview with Tilman Baumgaertel, they state:

> The Internet is the environment in which our work must be displayed. We are working with the connection speed of the Internet, or rather, with the connection slowness. That would get lost on a CD-ROM. (...) We have made about 150 changes since we started our website.[330]

[329] "Wir machen diese Sachen, weil wir wütend sind. Die Leute am anderen Ende, am empfangenden Computer, spüren diese Wut. (...)Wegen der Bedeutung von Technologie, zum Beispiel. Es ist offensichtlich, dass sich unsere Arbeit gegen High Tech richtet. Und wir kämpfen auch auf graphischer Ebene gegen den Computer." Dirk Paesmans, in: Tilman Baumgärtel, *Net.art: Materialien zur Netzkunst* (Nürnberg: Verlag für Moderne Kunst, 1999), 108, my translation from the German.

[330] "Das Internet ist die Umgebung (environment), in der unsere Arbeit gezeigt werden muss. Wir arbeiten zum Beispiel mit der Übertragungsgeschwindigkeit des Internets. Oder besser gesagt: mit der

To further support the argument that their work needs to be experienced individually, Jodi constantly update their website. Their main argument is that their work takes place in the computer, hence the personal relation of the user with the machine plays a significant role in their work. The computer is not, in the case of Jodi, a mere tool to display a work translated in digital ways, as for example a painting displayed in a dedicated fine art website, but it is the place where the work truly and exclusively exists. It is its ontological location: a work by Jodi doesn't exist anywhere else. Not only does the work not exist outside the computer, but it also doesn't exist exclusively in one single computer. The work taking place in the artist's machine or in the viewer's one is the same and it wouldn't make any sense to speak of an original and a copy. But the main reason why Jodi's website needs to be experienced at home, through one personal computer, is that it allows a more intimate, and probably unsettling experience. Jodi's website plays with the anticipations and fears of the spectator as he comfortably surfs on the web on his personal computer. Fears of hacking, viruses and all sort of piracy regarding the internet had become a common concern by the end of the twentieth century, probably nurtured, in part, by the companies producing software to counter these dangers. Although in reality inoffensive, Jodi's work destabilizes the viewer by exploiting the formal elements that characterise crashes and virus infections.

The anxiety produced by the experience can only occur if the viewer uses his or her own personal computer, or at least it is more intense, as the artists state: "It's a transgression into your personal space – it doesn't work on public computers."[331] While this is the reason why the artists considered that their website should be rather experienced through one's own personal computer, at home, it has also determined the organisation of their website. Instead of creating a classical one, presenting their curriculum, works and exhibitions in an ordered fashion, Jodi's website is a work of art in itself, constantly changing and evolving, without any practical information about the artists or the works.

Übertragungslangsamkeit. Das ginge verloren, wenn es auf einer CD-ROM wäre. (...) Wir haben ungefähr 150 Änderungen vorgenommen, seit wir unsere Site gemacht haben." Ibid., 107, my translation from the German.

[331] Dirk Paesmans, in: Tilman Baumgärtel, *Net.art 2.0: neue Materialien zur Netzkunst* (Nürnberg: Verl. für Moderne Kunst, 2001), 171.

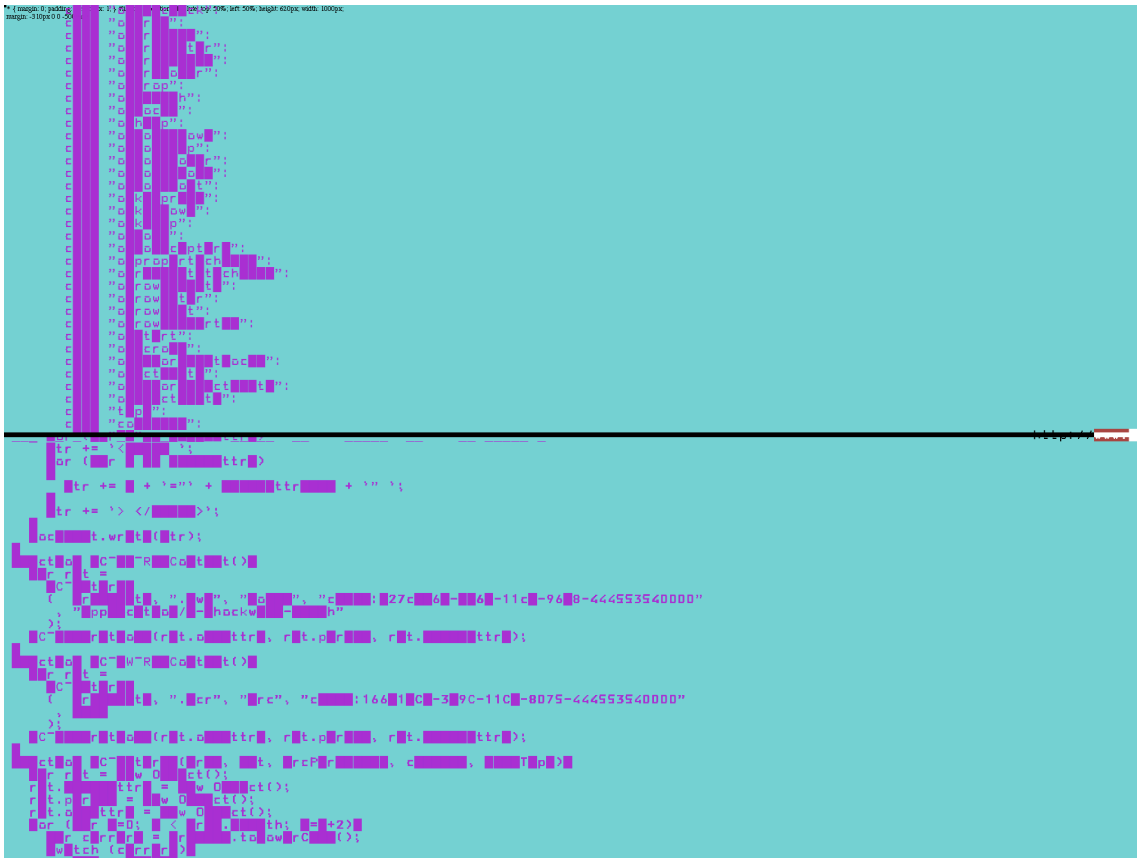

Figure 22 Jodi, *Wrong Browser*. Screenshot November, 2013. Courtesy of the artist.

Figure 23 Jodi, *Wrong Browser*. Screenshot November, 2013. Courtesy of the artist.

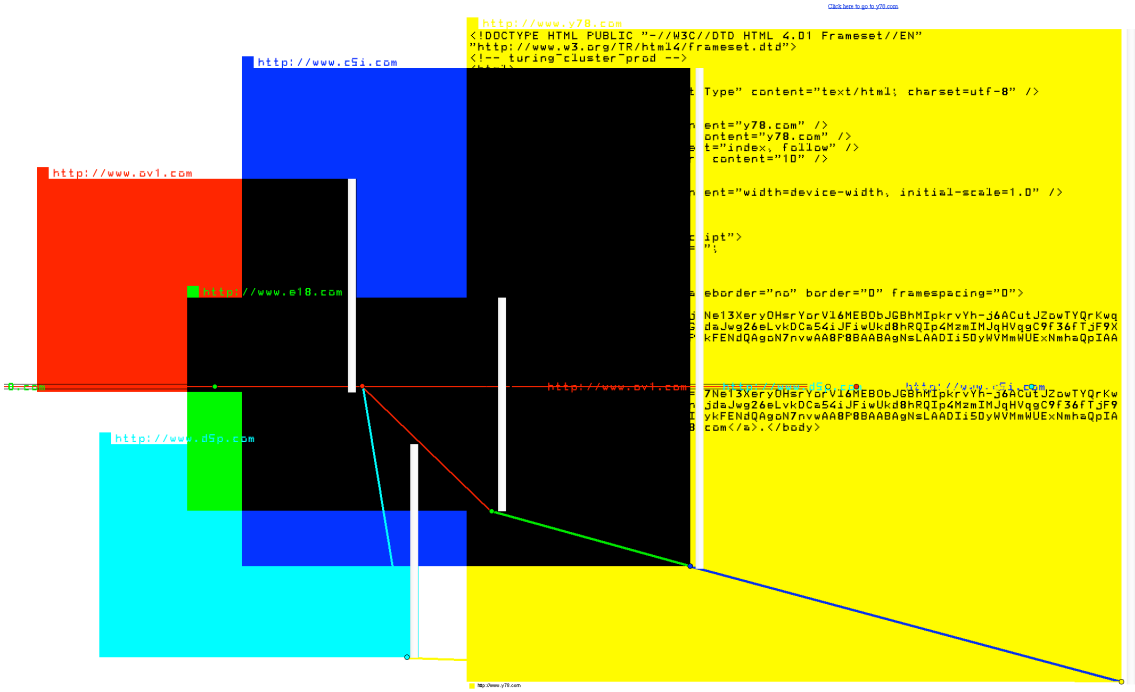

Figure 24 Jodi, *Wrong Browser*. Screenshot November, 2013. Courtesy of the artist.

4.4 Online and Offline: Problems of Presentation

The analysis of Jodi's works and ideas clearly show that the internet was the appropriate place to present the artists selected by Simon Lamunière for the media art section of documenta X. This is particularly true for the work of Jodi, but similar conclusions could be made for the other selected works. However, Simon Lamunière and Catherine David's decision to present these artists in the physical spaces of the exhibition (from June 21 to September 28 1997) in addition to the website was understandable. Because the media art project was commissioned and developed during the last year of preparation for the exhibition, Simon Lamunière justified the choice of the documenta-Halle, to host the showroom for the artists, because all of the other spaces were already occupied.[332] In addition, the documenta-Halle was interesting for the curator because it hosted the auditorium dedicated to the *100 days - 100 guests* conferences and discussions. Consequently, the media art works would be presented in close proximity to the symbolic heart of the documenta, given that the tenth edition was strongly focused on ideas and debates. The question of how to present works created with a computer and to be viewed on a computer, additionally exploiting the interactivity of the Internet, has certainly gone through many discussions and difficult decisions. Eventually, the works selected by Lamunière were presented with an elementary disposition of ten white aluminium tables and red office chairs. Each table was provided with a computer and a monitor, together with a file holder displaying the documentation of the artists. The room was conceived by Heimo Zobernig, who created a closed space, in which the walls were painted in ultramarine blue. Zobernig, who also imagined the auditorium for the *100 days - 100 guests* conferences, described his idea behind the internet room in a project submitted to the curator: "This room is conceived to be autonomous from its functional use, having neutral aesthetic and sculptural qualities."[333]

---

[332] Simon Lamunière, interview with the author in Geneva, 7 January 2013.

[333] "Dieser Raum ist so konzipiert, dass er unabhängig von seiner funktionalen Verwendung, selbständig ästhetisch/skulpturale Qualitäten hat" Heimo Zobernig, "Letter to Catherine David - Einrichtung für ein UTV-Fernsehstudio", 10.2.1997 (documenta Archive Kassel: D10, Mappe 336), my translation from the German.

This paragraph confirms the intention to create a neutral space for the presentation of works of computer art.

Once open to the public, the showroom conceived by Zobernig was quickly associated with an office space, not without criticism from some of the journalists that described it. Michael Gibbs from *Art Monthly*, affirmed that: "The presentation of the internet projects at the documenta-Halle, where they are relegated to a sterile, office-like space under the stairs, with standard grey computers sitting on an array of tables, could have been more imaginatively designed."[334] *Der Tagesspiegel* of Berlin, described the space in analogous terms, while questioning its appropriateness: "The Internet room of the documenta appears as nothing else but a modern large office. (…) The display of 'immaterial' net art confronts curators with entirely new problems. It is unlikely that in the future the presentation of net art will resemble the one at documenta."[335] The choices behind the presentation of the works in the physical space reflected the will of the curators to integrate the works into the general discourse and visions of the documenta. For Catherine David, it was important that the works of computer art were part of the show. However, during the press conference presenting the website project, she made the following observation: "Of the concentric circles which constitute the cultural event documenta X, the website is so to speak the outermost ring."[336] The outermost ring could be interpreted as the one closer to the public and the outside world, which is comprehensible, because the Internet is conceived as a portal between the documenta and the world. On the other hand, one could speculate that the 'outermost ring' is the furthermost ring from the core concerns of the curator, the reason why she delegated the curatorial project to Simon Lamunière and a possible explanation as to why the physical presentation of the works was conceived when 'everything was already taken'.[337] In an email to Simon Lamunière,[338] Catherine David asked him to

[334] Michael Gibbs, "On and Off Line at documenta X", *Art Monthly*, September 1997 (documenta Archive Kassel: d10, Mappe 40), 51.
[335] "So sieht der Internet-Raum der documenta nicht anders als ein modernes Grossraum-Büro. (...) Die Präsentation der 'immaterialen' Netzkunst stellt Ausstellungskuratoren von vollkommen neue Probleme. Dass die Präsentation von Netzkunst in Zukunft so aussehen wird wie auf der documenta, darf bezweifelt warden" Tilman Baumgärtel, "Das Reich ohne Sinne", *Der Tagesspiegel*, Berlin (02.08.1997) (documenta Archive Kassel: d10, Mappe 34), my translation from the German.
[336] Catherine David, "Statement", March 21 1997 (documenta Archive Kassel: d10, Mappe 275).
[337] Simon Lamunière, interview with the author in Geneva, 7 January 2013.
[338] Catherine David, email to Simon Lamunière, (documenta Archive Kassel: d10, Mappe 275).

manage all the correspondence with the artists involved in the media art project. Indeed, there is not one single exchange between Jodi, for example, and Catherine David in the archive of the documenta, beside a succinct contract.

The decision to create a showroom similar to an office was in part dictated by finance and space availability, it was nonetheless a curatorial decision. Simon Lamunière clearly did not intend to create a metaphor of the Internet with a theatrical setting; he wasn't interested in creating a place resembling a futuristic stage. In interpreting his curatorial choices, one could conclude that he took particular care not to create the impression of the media art showroom as an expression of an ingenuous fascination for modern technologies. During a personal interview, Lamunière described to me his vision of the showroom: "I told myself that we had to create a familiar environment to show all these works, because at that time there were only technological exhibitions, with Plexiglas furniture and all that. I wanted to create a very simple environment resembling either an office or a library."[339] This description supports the hypothesis that the curator desired to avoid any association with a technophile ideology, for his media art exhibition. The simplicity of the Internet showroom corresponded to the general curatorial aesthetic of documenta which privileged content over form, discourse over aesthetic celebration.

An additional concern that the curator had to face, however, was the online connection itself. The question was whether the work presented in the showroom should be actually connected to the Internet, during the opening hours of the exhibition. Some of the works selected could easily be presented off-line, with little modification to their original presentation in a web environment, but some would lose their distinctive character. This was particularly true for Jodi, whose work was not only created for the Internet, but also exploited web resources to generate its chaotic output. The generative aspect of the work by Jodi, which was the aesthetic characteristic of their work, required an Internet connection to function. The logical solution was then to supply an online connection and allow the work to function as intended. Furthermore, documenta was supported by

[339] "Je me suis dit qu'il fallait créer une ambience familière pour montrer ça, parce que à l'époque il n'y avait que des expositions technoides, avec des sièges en coque plastique, etc. Je voulais créer un environnement extrèmement simple qui ressemblait soit au bureau soit à une bibliothèque" Simon Lamunière, interview with the author in Geneva, 7 January 2013, my translation from the French.

sponsors IBM and SBK Software + Systeme, who provided financial and technical support for the event, motivated by the fact that the Internet project was an important and innovative feature of the tenth edition of documenta. The final decision reached by the curators, however, opposed the installation of an active online connection for the benefit of those works presented in the showroom. In the end, there was no connection and the works were shown off-line, with the content locally stored in the hard disk of the computers. This decision quite understandably generated vivid debate.

The controversial decision to present the works off-line, was indeed made for curatorial reasons instead of technical ones. Simon Lamunière feared that the showroom would become an Internet cafe in which visitors would rather read their emails and surf the web, instead of consulting the works. He wanted the spectators to focus on the media art works, not on the Internet. By refusing to provide an Internet connection, while simulating it and having all the data stored in each hard drive, the curator ensured that the public would concentrate exclusively on the selected works. In addition, only one work was displayed in each computer station, a choice resembling curatorial standards of more traditional artworks, in which each individual work is attributed its own space of presentation. This curatorial strategy reflects Lamunière's opinion that computer art should be discussed and exhibited under the same conditions of presentation used in the visual arts. This is, above all, the reason why he resolved not to provide an online connection in the showroom of the documenta-Halle, despite the fact that it was to be regarded as a contradictory one. In addition, Simon Lamunière had another concern, namely that the website would be attacked by hackers. Indeed, he confided that in the three months prior to the opening of the documenta, when the website was already online, it has been subject to several attacks.[340] He confirmed that the attacks were not claimed, nor was it clear why they had been perpetrated. Nevertheless, it was a concern that played a role in his decision to keep the works offline in the hall.

Despite the decision to exhibit the work offline, the presentation of the artists whose work appeared on the website went ahead in the documenta-Halle, and their presence

[340] Simon Lamunière, interview with the author in Geneva, 7 January 2013.

was also acknowledged in the official plan and list of the exhibition.[341] To adapt to the situation of the showroom and the absence of online connection, Jodi displayed another work in the physical space of documenta, instead of the one presented online. In the documenta-Halle, they installed an adaptation of their recent work *map.jodi.org* (1997), a personal interpretation of an interactive map of the web, inspired by diagrams showing the most important institutions related to the internet, diagrams that were circulating on the Internet at that time. The artists changed the links to the institutions appearing in the original maps and replaced them with websites dedicated to alternative and creative uses of the Internet. However, because the showroom in the documenta-Halle was not provided with access to the Internet, Jodi intentionally programmed the computer to crash when a user clicked on one of the links of the map.[342]

While the room dedicated to works of net art in the hall of the documenta did not have internet access, the works presented online on the exhibition's website were obviously available to everyone. The website, accessible three months prior to the opening and throughout the whole period of the exhibition, was conceived by the curator as a platform to provide practical information, display the works of computer art and offer a forum to discuss the event. The website was structured in a rather functional way, with pictograms composed by the curator, allowing a fairly intuitive navigation. As a pioneering example of a website presenting these specific works of art, it would have been advisable to keep the website online after the exhibition in Kassel had ended, thereby providing an online documentation of the works. Nevertheless, the website was closed at the end of the event. The decision was taken by Lamunière himself, who decided that the website, as an experiment of computer and internet art during documenta X, should be limited to that period of time. Above all, the curator feared that the website, if it was kept active after the show and beyond his care, would be modified with the time, with new information replacing old, as is the norm with the majority of websites. It was therefore a logical decision for Simon Lamunière and Catherine David to close the site. In their view, although it might appear to be a contradiction, the decision to close the website was intended as a means to better preserve it. After the

[341] (documenta Archive Kassel: d10, Mappe 84a).
[342] See the description of the work in: Tilman Baumgartel, "Interview with jodi", 28 Aug 1997. http://www.nettime.org/Lists-Archives/nettime-l-9708/msg00112.html.

exhibition, the content of the website was transferred and stored in a CD-ROM, produced by documenta in several editions available for purchase.

This decision, again, was not met with favourable criticism, in particular by some of the artists and critical theorists involved in the media art field. Vuk Ćosić, a Slovenian computer artist collaborating with the cluster of theorists and artists subscribed to the mailing list *Nettime* and who founded the Ljudmila digital media art lab in Ljubljana, copied the whole documenta website after its official closing and made it available online on his own website.[343] The artist provocatively considered the copy of the website as a work of his own, sometimes referring to it as a ready-made of the new Internet era.[344] This provocative action contributed to the international recognition of Vuk Ćosić, who would represent Slovenia at the Venice Biennale, in 2001. He also intended to preserve the site of the documenta, the works created for it and at the same time to elicit debate on the problematic position of artists engaging with ephemeral media such as computers and the Internet. Simon Lamunière and Bernd Leifeld, the managing director of documenta X, discussed the fact in a series of email exchanges.[345] The managing director questioned if the act by the Slovenian artist was an act of piracy and whether the Institution should prosecute the artist. In his reply, Lamunière suggested that they avoid engaging in any legal action, although he declared that he did consider the act to be one of piracy. The dialogue between prominent personalities in the media art world and traditional institutions of art was evidently not without friction even in the nineties.

[343] See, for example, the article reporting the event by Tapio Mäkelä, "Tales from Deep Europe", in *SIKSI magazine*, n.4, Winter 1997.
[344] Vuk Ćosić, interview with the author in Ljubljana, 25 November 2012.
[345] Bernd Leifeld, email to Simon Lamunière (documenta Archive Kassel: d10, Mappe 275).

Figure 25 View of the media art showroom in the documenta-Halle in 1997.
Photograph by Ryszard Kasiewicz, © documenta Archiv. Used with permission.

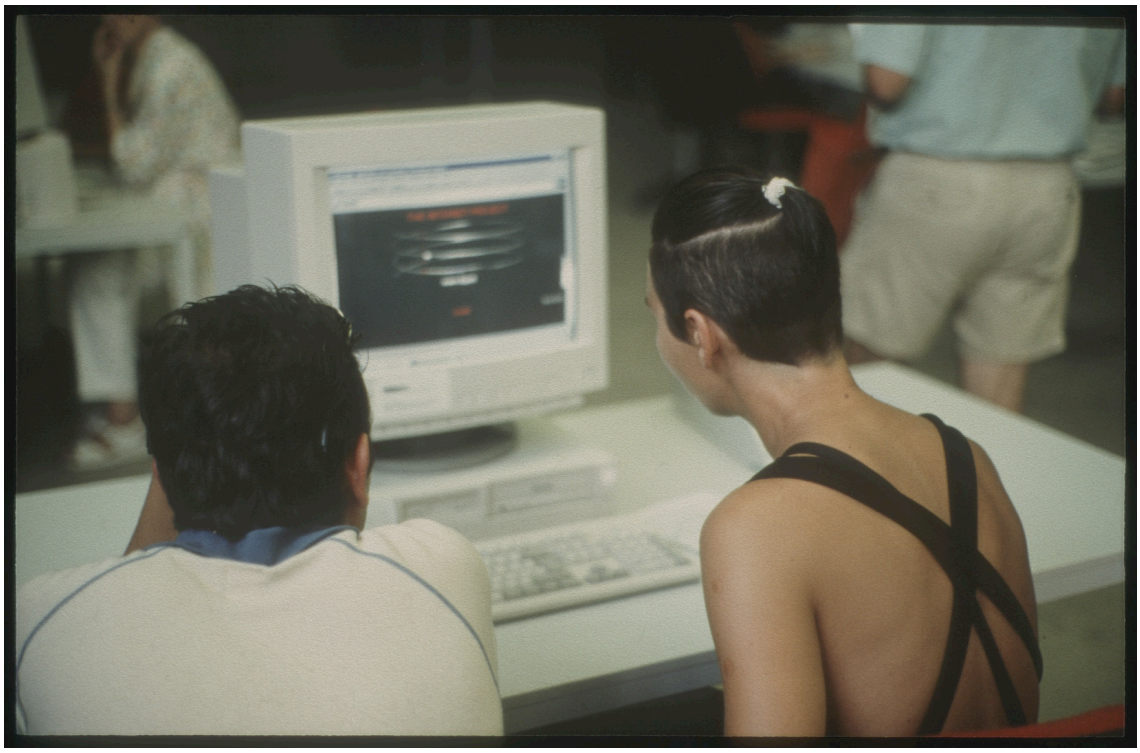

Figure 26 View of the media art showroom in the documenta-Halle in 1997.
Photograph by Harald Bernstein, © documenta Archiv. Used with permission.

4.5 Reception of Media Art

documenta X was visited by 629,000 people, surpassing the number of visitors of all the previous editions, although this increase should be seen within the context of an upward trend, which characterised all future editions of the festival. The total budget for the event was of 21.73 million DM, while the website project directed by Simon Lamunière had an estimated budget of 200,000 DM.[346] The final documenta X report does not list the costs of the website project separately, but an intermediary budget submitted by Lamunière at the end of the show, in September 1997, indicates that the costs did not surpass the previous estimate.[347] The number of visitors, and the administration of the budget were testament to a successful event, although the success of an exhibition cannot be measured in numbers alone. What was the reception of the event on a more qualitative level? How were the works of computer art presented in the showroom of the documenta-Halle - in particular the work by Jodi - critically received by press from the art world and in general? Analysis of the articles written during the documenta X exhibition provides some answers to these questions.

As a first observation, it can be said that the articles published in some of the important newspapers in Europe, reveal a mixed reception of documenta X. In France in particular, the work of Catherine David was met with harsh criticism; however, critics in Germany, Italy and the United States also questioned her work. The most recurrent objection to David's curatorial approach was that she gave too much emphasis to concept and content at the expense of form and aesthetic. documenta X was sometimes criticised as being too pretentious, sometimes too obscure, while others even considered it boring or lacking artistic interest.

---

[346] The information concerning the number of visitors and the total budget are indicated in the official website of the documenta Archive: http://www.kassel.de/miniwebs/documentaarchiv_e/08205/index.html.

[347] The documents concerning the website project, the estimated budget and intermediary report are in the documenta Archive Kassel: d10, Mappe 275.

But a more interesting observation is that documenta X was, from the very start, associated with new technologies and media art. This is probably a consequence of the artistic director's curatorial position stressing that artworks should not be separated according to technique but rather according to conceptual and thematic qualities, which also played a significant role in the selection of the works. The important involvement of photography, video and computer art - whose presence at documenta X was perceived as disproportionate compared to more traditional techniques - fitted an approach more oriented towards questions related to documenting and investigating contemporary society, which was valued by the curator.

Ken Johnson's article covering documenta X, for *Art in America,* was entitled "A post-Retinal documenta."[348] Benita Munitz, from *Cape Times*, gave her review the playful title "It's virtually art at show"[349] while *Il Giornale dell'Arte*, in the title of its review, states that documenta X is "da cliccare più che da vedere,"[350] that is to say: the exhibition offers more to click than to see. Another Italian newspaper, *La Repubblica*, offered a comparison of the documenta exhibition with the Venice Biennale taking place in the same year, an exercise undertaken by many art critics, particularly in Italy. The title of the article was again an allusion to the alleged technological penchant of the exhibition in Kassel: "Chi ha paura della tecnologia?" (Who is afraid of technology?). Interviewed by Paolo Vagheggi, the artist Fabrizio Plessi affirmed that if the Venice Biennale was too traditional, the documenta had fell in the opposite traps of complying too much with new technologies:

> The problem of Kassel is to have opened a path in opposition to the Venetian one. I believe that the two poles should cohabit. Art involved with technologies shouldn't be a substitutive one. (…) Catherine David shifted too much to the opposite end of the spectrum, because technologies should instead be elevated to an appropriate level of cultural dignity, otherwise they will persist as mere experiments.[351]

[348] Ken Johnson, "A Post-Retinal documenta", in *Art in America*, October 1997 (documenta Archive Kassel: d10, Mappe41), 81.

[349] Benita Munitz, "It's virtually art at show", in *Cape Times*, 24 July 1997 (documenta Archive Kassel: d10, Mappe40).

[350] Mary Rozell Hopkins, "documenta X: da cliccare più che da vedere", in *Il Giornale dell'Arte*, n.156, June 1997 (documenta Archive Kassel: d10, Mappe 44).

[351] "Il problema di Kassel è di avere individuato una strada che è in contrapposizione a quella veneziana. Ritengo invece che i due poli debbano convivere. Quella delle tecnologie non è un'arte sostitutiva. (...) Catherine David si è spostata troppo sul fronte opposto anche perché le tecnologie devono essere elevate a un livello di dignità culturale, altrimenti resteranno solo sperimentazioni" Paolo Vagheggi

The general impression that the 1997 edition of the documenta was burdened by new technologies is acknowledged by Robert Storr, as well. In an interview with Catherine David for *Artforum*, the American critic questioned the French curator about the rumour preceding the opening of the event:

> Robert Storr: The word is out that documenta will lean very heavily toward video, toward technological arts of one kind or another. Is that true? Catherine David: No, it's not true at all. (...) I think we did the opposite of a technological show, and I hope that we worked carefully enough that the question of technology versus art won't be relevant. That's a very old debate, and we've been neither naively pro-technology nor have we been treating new media as the contemporary incarnation of Satan. I think that new media are simply tools.[352]

Even if Catherine David affirmed in the printed statements, in the website and during the interviews that she was not interested in new technologies and media art per se and dismissed the idea that her exhibition was a technological one, the image of a documenta leaning towards new technologies in art and discarding older ones is evident in the writings of journalists that attended the event. The reactions were mixed, but in the case of the critics who wrote a rather negative review of the event, the importance given to new media was just one of the arguments posited in discrediting the curatorial work.

The technological inclination of the documenta X exhibition might have been exaggerated by journalists and dismissed by Catherine David, nonetheless the media art room curated by Simon Lamunière was indeed an exercise in the presentation of media art work to a wider public. It is therefore interesting to consider, apart from the general criticism, how this specific venue and the work presented were received, and in particular the work by Jodi. Several local newspapers dedicated an article to the website project, mainly after its presentation during the press conference. Very often, these articles simply report the information about the project without providing any elaborate criticism. This is possibly due to the lack of a theoretical framework, which would have allowed for an analysis of the computer art works presented. Some authoritative

---

interview to Fabrizio Plessi, "Chi ha paura della tecnologia?", in *La Repubblica*, 1 September 1997 (documenta Archive Kassel: d10, Mappe 44), my translation from the Italian.

[352] Robert Storr, "Kassel Rock - Robert Storr talks with documenta's Catherine David" *Artforum*, May 1997, (documenta Archive Kassel: D10 Mappe 40), 78.

positions in the general press, venture into a deeper analysis of the project. The reaction is not always positive: Caro Maurer und Marion Leske, in an article entitled "Irritationen im Internet" which appeared in *Die Welt* prior to the opening of the exhibition, wrote "Here is the Internet at its best: even online art lives more from explanations and less from perceptions." The authors suggested that the "cyber artists irritate more than they inform" and finally concluded that "perhaps it is better that we continue our live tour on our own and we let the reality in Kassel itself surprise us."[353] Even more radical were the reviews of some important newspaper correspondents following visits to the exhibition and the website works presented in the documenta-Halle. Waldemar Januszczak from *The Sunday Time* calls it a "Poor Show", (the title of the article), while he addresses the works of computer art with the following statement: "There are Web sites on which an international assortment of artistic complainants click their way through endless lists of laments upon the way our cultural lives have developed."[354] *Der Spiegel* specifically addressed the presentation of the works in the documenta-Halle reporting that: "In order to prevent visitors from surfing around at will, the internet connection stops at the wall." The conclusion of the influential German weekly news magazine was rather sceptical: "With all the theorizing and good-intentioned artistic activism, on the Website the results are ultimately too messy. Quivering video clips and flashing English texts are sorely missing a formal layout."[355] These examples show that, for the most part, the works of computer art selected for the website and showroom were criticized by journalists from non-specialised media.

While the supposed technological inclination of the documenta X received a rather unenthusiastic reaction by the general press, the media showroom was fairly positively received by the periodicals specialized in contemporary art. *Art in America* dedicated a

[353] "Da ist das Internet ganz auf der Höhe der Zeit: Auch die Online-Kunst lebt mehr von der Erklärung als von der Anschauung (…)Cyberkünstler halten mehr Irritation als Information parat (…) so weit unser mehrstündiger Ausflug in die virtuellen Künste. Vielleicht doch besser, wir reisen live und höchstselbst und lassen uns von der Wirklichkeit im realen Kassel überraschen." Caro Maurer and Marion Leske, "Irritationen im Internet", in *Die Welt*, 4.4.1997 (documenta Archive Kassel: d10, Mappe 34), my translation from the German.

[354] Waldemar Januszczak, "A poor show", in *The Sunday Times*, 29 Jun 1997 (documenta Archive Kassel: D10, Mappe 40), 11.

[355] "Damit Besucher nicht etwa beliebig und kunstferne umhersurfen, reicht das Internet halt nur bis zum Wandstecker (…)Bei allem Theoretisieren und gutgemeintem Künstler-Aktionismus: Auf der Website geht es am Ende gar zu unübersichtlich zu. Zitternde Videoclips und vorbeiflitzende englische Texte lassen formale Gestaltung schmerzlich vermissen." "Ausser Sichtweite", in *Der Spiegel*, 31.7.1997, (documenta Archive Kassel: d10, Mappe 34), my translation from the German.

section to the media art presence at the documenta, with an article by Christopher Phillips, sustaining that: "this first-ever documenta presence on the Internet marked an unexpectedly bold artistic advance into the digital frontier."[356] Wolf-Günter Thiel, writing for the international edition of *Flash Art*, integrated the website project room, together with the Hybrid Working Space dedicate to media art as well, in the list of places that "are valid and worth visiting."[357] Andreas Broeckmann, affirms that "the tenth documenta has the ambition to be sensitive about social problems and to break the narrow boarders of art." After describing the website project, he concluded that "the chances are not bad for this."[358]

For what concerns the artist duo Jodi, in particular, their work often appeared as an image supplementing the article in the general press, but it was rarely described and analysed in the body of the article itself. The description of the work by Jodi was often limited to the photo legend. Some journalists simply described it as "Eine Internet-Seite" (an Internet site)[359] while others further described it as an "ironische –website" (an ironic website).[360] Torben Müller, writing for the *Neue Presse* from Hannover, provided a more elaborated legend for the work of Jodi: "Chaos as artwork: the 'jodi'-project on the documenta website shocks Apple-users with fallacious virus attacks."[361]

On the rare occasions that the work by the artists was actually discussed in the article, it was generally positively received. For *Die Welt*, the artists "play with the absurdity of all the available data and ironize – albeit somehow weakly – the users wandering in the

---

356 Christopher Phillips, "Digital documenta", in *Art in America*, October 1997, (documenta Archive Kassel: D10, Mappe41).

357 Wolf-Günter Thiel, "The German Summer", in *Flash Art*, October 1997 (documenta Archive Kassel: d10, Mappe 41).

358 "die zehnte documenta tritt mit dem Anspruch an, sensibel zu sein für gesellschaftliche Probleme und für das Durchbrechen der engen Grenzen der Kunst (…) Die Chancen dafür stehen nicht schlecht" Andreas Broeckmann, "www.documenta.de" (documenta Archive Kassel: d10, Mappe 34), my translation from the German.

359 Dirk Schwarze, "Ausstellung im Internet gestartet", in *Hessische/Niedersächsische Allgemeine*, 22.3.1997 (documenta Archive Kassel: d10, Mappe 34), 25.

360 Christoph Blase, "U-Bahn nach Kassel, Station Ägypten", in *Frankfurter Allgemeine Zeitung*, 24.3.1997 (documenta Archive Kassel: d10, Mappe 34), 38.

361 "Chaos als Kunstobjekt: Das 'jodi'-Projekt auf den documenta-Seiten schockt Apple-Nutzer mit vorgeflunkertem Virenbefall" Torben Müller, "Wenn's wir im Obstdesign daherkommt, ist es Kunst", in *Neue Presse Hannover*, 7.8.1997 (documenta Archive Kassel: d10, Mappe 34), my translation from the German.

labyrinth."[362] For the *Neue Presse*, Jodi "creates a completely new and unusual PC-environment."[363] Finally, for the *Frankfurte Allgemeine Zeitung*, Christoph Blase wrote that:

> Joan Heemskerk and Dirk Paesmans engage the visitors of 'jodi.org' with visual effects throwing a new picture on the screen with every click, giving the impression that one has slipped into several wrong programs and at the same time that the computer has crashed. In this way, the question of the aesthetics of the user interface is approached with a subtle irony.[364]

Quite surprisingly, if on the one hand works of computer art in general and the alleged technological inclination of the exhibition were condemned by the non-specialised press, on the other the few articles describing Jodi's work rather praised its ludicrous charm.

The press specialised in contemporary art was even more explicit in its positive response to the work of Jodi. For *Texte zur Kunst*, Gerrit Gohlke wrote:

> In this irresolution, in which art is placed next to simple information, the projects that flirt with the aesthetics of sabotage are those that best assert themselves. Joan Heemskerk and Dirk Paesman have staged an effective game with the horrors of the use of computers, bringing by means of frustrated expectations, as well as through many 'Without Addresses' the reading process itself to consciousness.[365]

Andreas Broeckmann clearly considered the duo to be two of the most interesting protagonists in computer art on the web:

---

[362] "spielen mit der Absurdität der verfügbaren Daten und ironisieren - wenn auch ein bisschen flau - des Users Irrgänge im siesinge Labyrinth" Caro Maurer und Marion Leske, "Irritationen im Internet", in *Die Welt*, 4.4.1997 (documenta Archive Kassel: d10, Mappe 34), my translation from the German.

[363] "kreieren damit eine ganz neue, ungewöhnliche PC-Umgebung" Torben Müller, "Wenn's wir im Obstdesign daherkommt, ist es Kunst", in *Neue Presse Hannover*, 7.8.1997 (documenta Archive Kassel: d10, Mappe 34), my translation from the German.

[364] "Bei den visuellen Eindrücken greifen Joan Heemskerk und Dirk Paesmans ein und schleudern dem Benutzer bei 'jodi.org' mit jedem Klick ein neues Bild auf den Monitor, das aussieht, als sei man in mehrere falsche Programme gerutscht und im selben Augenblick der Computer abgestürzt. So wird mit feiner Ironie die Problematik der Ästhetik der Benutzeroberflächen auseinandergenommen" Christoph Blase, "U-Bahn nach Kassel, Station Ägypten", in *Frankfurter Allgemeine Zeitung*, 24.3.1997 (documenta Archive Kassel: d10, Mappe 34), 38, my translation from the German.

[365] "In dieser Unentschiedenheit, in der Kunst neben der schlichten Information plaziert werden soll, behaupten sich am besten noch jene Projekte, die mit der Ästhetik der Sabotage kokettieren. Joan Heemskerk und Dirk Paesman haben ein wirksames Spiel mit dem Schrecken der Computernutzer in Szene gesetzt, das durch das Mittel der Erwartungsenttäuschung ebenso wie 'Without Addresses' den Lektüreprozess selbst zu Bewusstsein bringt" Gerrit Gohlke, "Inzwischen weit verbreitet", in *Texte zur Kunst*, Juni 1997 (documenta Archive Kassel: d10, Mappe 34), 165, my translation from the German.

> For many years, Jodi's website has been considered among the most interesting, curious and best ones. (…) For the documenta, Jodi also work, among other things, on their virus-site.[366]

Michael Gibbs, writing for the *Art Monthly*, described their work in the following terms:

> Jodi's extraordinary and subversive delvings into the heart of electronic syntax, featuring cascading graphics that play havoc with the idea of 'user interface'.[367]

Writing for *Art in America*, Ken Johnson, although critical of most of the computer art works at the documenta, regarded the work created by Jodi as one of the few interesting one:

> On the other hand, there was an amusing Internet piece by a programming team called Jodi (Barcelona) which gave you an absurd collage of generic menus, windows and icons that multiplied ridiculously as time passed – a clever play on the new vernacular environment of virtual life, but hardly mind-altering.[368]

What is interesting to retain, particularly from the articles that dedicated a few lines of comment to Jodi's work, is that it is precisely their subversive approach to computer technology that is usually stressed as interesting and innovative. This is exactly the aspect that the curator of the website project, Simon Lamunière, as we have previously observed, considered important in his selection of the works. It is probable that the reaction of the press was in part influenced by the curatorial positions divulged during the press release and in the short guide presenting the works. However, it also confirms that works of computer art were ready to be accepted within a cultural show as long they presented an ironic and playful critique of modern technologies and machines.

If Jodi's contribution to the documenta X received favourable reviews both from the general press as well as from the specialised one, the reaction of the artists themselves concerning the presentation of their work has been a different one. The website created

---

366 "Jodi' beispielsweise, deren Website seit Jahren zum Besten, Interessantesten, Seltsamsten gerechnet wird, was auf dem Netz passiert (...). Für die documenta arbeiten Jodi unter anderem an ihren Virus-Seiten weiter" Andreas Broeckmann, "www.documenta.de" (documenta Archive Kassel: d10, Mappe 34), my translation from the German.

367 Michael Gibbs, "On and Off Line at documenta X", *Art Monthly*, September 1997 (documenta Archive Kassel: d10, Mappe 40), 51.

368 Ken Johnson, "A Post-Retinal documenta", in *Art in America*, October 1997 (documenta Archive Kassel: d10, Mappe 41), 85.

by Simon Lamunière hosted a forum in which artists, critics and the public were invited to post comments on the event. Joan Heemskerk and Dirk Paesmans posted the following single comment:

> The net.room simulates an office; with office-tables, office-chairs, office-desk furniture, all organised 'just like at the office'. This office-setting was 'specially created for the presentation of 9 artist's net.projects in documenta X. It's an unnecessary confusing symbolical construct, built without the consultation of the artists. Net.projects don't need such metaphors when presented in real-space exhibits, as tv-monitors don't need a home-decor around them for viewing video. The office-cliché also sucks because it gives a false group-label to artists whose only thing in common is their use of the net, and categorises them, in opposition to the rest of the exhibition, by technique.[369]

The artists are obviously unhappy with the presentation of their work, from their comment it appears clear that they considered the presentation at documenta and its setting to be inappropriate. They also complained about having not been consulted by the curator. In their opinion, the works didn't need a metaphorical setting to be appreciated, a position that should have matched the one of the curator who stressed how important for him it was to focus the attention on the works. Yet, in Jodi's opinion, the office setting was not the proper one. As the two artists asserted several times, they were convinced that their work would be better experienced on one's own personal computer. Nevertheless, for a presentation of their work in an exhibition space another solution was necessary. What would have been the suitable solution for the artists?

During an interview with Tilman Baumgaertel, reproduced on the mailing list *Nettime*, Dirk Paesmans is questioned about alternative ways of presenting their work in a physical place. The artist emphasised the importance of collaboration with the artists involved, instead of mandating the conception of the setting to another artist such as Heimo Zobernig, as was the case in Kassel. In his words:

> I personally think that if you have a space and decide to show net works, you can also present it to people who are not used to computers. And you could also give the artists the opportunity to add things to their installation. I think it is very important for net artists to deal with the presentation, or they will be re-presented by other people; for example, designers who are asked to design to exhibition space. That's the worst. One should avoid that at all costs. All the different works disappear in the set up by the one guy who deals with the real

[369] Jodi, "dx webprojects", posted Wed, 9 Jul 1997 in: http://www.documenta12.de/archiv/dx///english/debatea.htm.

> space. The real space is of course much more powerful than all these networks. When you are viewing the work you are in the real space. If you only do your work on the net, you become a fragment of the local situation and you can easily become manipulated in any direction.[370]

Jodi's concern about the presentation of their work in the documenta-Halle was perceived as even more disappointing because it was the first important occurrence of a presentation of works of Internet art in an international context. Concerning the office metaphor, as a setting to display their work, they affirmed that: "it is vulgar, it's too easy. It doesn't work." Additionally, they feared that "it will be repeated over and over again."[371] The apprehension that the website project - both the online website and the media art showroom in the documenta-Halle - would become a paradigm for the presentation of works of computer art created on the web was also expressed by other media artists. Alexei Shulgin, Russian artist and curator, founder of the WWW-Art-Lab in Moscow, criticised not only the setting of the documenta showroom, but the curatorial selection of the works, as well.

> Since there is practically no critical context for net.art, we have really a big mess in this kind of approach and selection. Look at the documenta site [www.documenta.de]. It has a very different quality and trend and base works promoted as art works, it's because of this mess, of the impossibility to contextualise net.art.[372]

The participation of media art at the 1997 edition of documenta was awaited with both expectation and apprehension. In the end, after the initial fears of a technological show and some negative reviews of the curatorial approach, the general press - but more specifically the press specialised in visual art - welcomed the artists participating in the website project, in particular Jodi, with an overall positive reception. It is from the artist's corner, more particularly the artists engaged in the emerging Internet art cluster, that disapproval of curatorial choices concerning the selection and presentation of the works was strongest.

---

[370] Dirk Paesmans, in: Tilman Baumgartel, "Interview with jodi", 28 Aug 1997, http://www.nettime.org/Lists-Archives/nettime-l-9708/msg00112.html.

[371] Dirk Paesmans, in: Tilman Baumgartel, "Interview with jodi", 28 Aug 1997.,http://www.nettime.org/Lists-Archives/nettime-l-9708/msg00112.html.

[372] Alexei Shulgin, in: Josephine Bosma, "independent net.art - a talk with Jodi and Alexei Shulgin", *Rhizome*, Wed Jul 9th 1997, http://rhizome.org/discuss/view/29035/.

4.6 The Significance of documenta for Jodi

Although Joan Heemskerk and Dirk Paesmans criticised the presentation of their work in Kassel, disagreeing with the design choices of the room and its situation 'under the stairs' and 'behind a cafeteria', along with the decision to create a specific section for computer and internet art, their work did not go unnoticed. Reproductions of their work were published both in the general and dedicated press who seem to have appreciated and correctly interpreted their defiant use of media technologies. Jodi's website was characterised as ironic, amusing, playful and even subversive. How significant was Jodi's participation in documenta for their future career?

The first important recognition for the artists arrived one year after their participation in the exhibition in Kassel. In 1998, the artist duo was awarded the first prize of the Videokunstpreis at the ZKM in Karlsruhe, a prize founded in 1992 and open to a variety of media techniques since 1997. The Jury supported the decision with the following statement:

> JODI are among the first to do 'field research' in the realm of digital data. Not unlike the pioneers of early video art, who examined the 'inherent possibilities of the medium', JODI work with the materiality of pictures and text fragments of the user's desk top which they recombine and collage through their work. Consequential, analytic, and with a dash of irony, they demonstrate the 'cussedness of the computer'.[373]

The *Hessische/Niedersächsische Allgemeine* newspaper, relating the event, linked their winning of the award to their previous participation at documenta: "The multimedia artist Joan Heemsker and Dirk Paesmans participated in the internet artistic project of last year's documenta X. For the CD-ROM they have been awarded the main prize of 30'000 marks."[374] The following year, in 1999, Peter Weibel curated *net_condition,* an exhibition questioning the Internet and presenting artists working with this new media.

---

[373] "Jury Statement" in *Internatioanler Videokunstpreis 1998 = International award for video art 1998* (Karlsruhe: Zentrum für Kunst und Medientechnologie, 1998), 7.

[374] "Die Multimedia-Künstler Joan Heemsker und Dirk Paesmans hatten sich im vergangenen Jahr am Internet-kunstwerk der documenta X beteiligt. Sie erhalten den mit 30'000 Mark dotierten Hauptpreis für die CD-Rom" "dX-Künstlerduo prämiert", in *Hessische/Niedersächsische Allgemeine*, 24 October1998, my translation from the German.

The exhibition, in which Jodi participated, was held in Karlsruhe, Graz, Barcelona and Tokyo.

The Internet became a popular topic at the end of the millennium and several exhibitions and publications were created to present a selection of artists, in which Jodi were often involved. The November 2000 edition of the magazine *DU* was entirely dedicated to media art and the Internet. The title of the edition was suggestive: "Net.Art. Rebellen im Internet."[375] Jodi were invited to contribute to the edition with images from their website that would run all through the content of the edition, providing the visual background of many articles. *ESC*, a publication edited by the Media Arts Lab des Künstlerhauses Bethanien, offered a first chronology of the history of net.art, while boldly affirming its death in 1999. The majority of works that were presented at documenta X, including the work by Jodi, were mentioned in the chronology of the publication.

In 2002, the artistic duo was invited to create a solo show at Plug-in, an exhibition space in Basel dedicated exclusively to digital and media art directed by Annette Schindler. The exhibition was completed with a first monograph publication of their work, edited by Annette Schindler and Tilman Baumgaertel. In the publication, Jodi were presented as a new generation of media artists. In the catalogue, Josephine Bosman stressed that "with the development of cheap and easy to use technology, a new breed of media artist has emerged. Media artists of today do not necessarily respect the tools they work with and they do not always control them, either."[376] On a same note, Florian Cramer situated the work of the artists in the tradition of software and generative art, although challenging and subverting the usual strategies and approaches of the genre; in his words: "Jodi no longer synthesize instruction codes, but for the first time use them intertextually, as found material."[377] From these examples, we can deduce that the subversive and rebellious character of Jodi's approach in the new media art field

[375] *Du: die Zeitschrift der Kultur*, November 2000.
[376] Josephine Bosman, "Jodi and the cargo cult", in *Install.exe - Jodi: [plug in] Kunst und neue Medien, Basel, 18. September bis 27. Oktober 2002* (Basel: Merian, 2002), 90.
[377] Florian Cramer, "DISCORDIA CONCORS: www.jodi.org", in *Install.exe - Jodi: [plug in] Kunst und neue Medien, Basel, 18. September bis 27. Oktober 2002* (Basel: Merian, 2002), 78.

established very quickly after the first international presentation of their work at documenta.

It is difficult to appreciate the role played by the website project at documenta X in the career of the artists, but the response of the press, the prize at ZKM and the invitations to participate in many exhibitions and publications that multiplied in the following years suggest that documenta X has played a significant role for Jodi. On the other hand, if Jodi became an iconic duo in the new media art scene and are still considered among the few pioneers that shaped the emerging net.art movement, their success was often circumscribed to the new media art field. Analysis of their recent biography mentions some participation in important institutions such as the Centre Pompidou in Paris, Stedelijk Museum in Amsterdam and New Modern Museum in New York. Nevertheless, these participations were usually smaller contributions to group shows or activities thematically centred on new technologies: the great majority of the exhibitions to which Jodi participated in the years after documenta X were hosted by institutions specifically dedicated to media art. The media showroom in Kassel provided a chance for media artists such as Jodi to enter the door of the traditional art circuit. Catherine David's curatorial approach was driven by the conviction that it made no sense to distinguish between a diversity of techniques in art, and thus between new media and traditional art. However, the separation of the field of media art from the traditional art world seemed to grow wider after documenta X. During the exhibition in Kassel, Michael Gibbs, writing for *Art Monthly*, raised a question that, in light of the current debate concerning the alleged digital divide, could appear prophetic:

> The internet projects presented as part of documenta X may be state-of-the-art at the moment, but will such works ever become art of the state. In other words, can they be co-opted into the traditional art system? Or will they have to be content with a virtual, ephemeral existence, viewed only by like-minded aficionados?[378]

According to the majority of actors involved in the media art field today, and despite the intentions manifested by David and Lamunière, it seems that the evolution of media art has leaned towards the second, most pessimistic option envisaged by Gibbs.

[378] Michael Gibbs, "On and Off Line at documenta X", *Art Monthly*, September 1997 (documenta Archive Kassel: d10, Mappe 40), 51.

4.7 Subversive Drives in Media Art

The presentation of media art at documenta X, and more particularly the participation of Jodi, was an important moment in the history of computer art. It also provides some interesting new elements for the analysis of the relationship between media art and the traditional contemporary art world, to which the exhibition in Kassel belongs and is among the most important international venues.

From the analysis of the curatorial criteria and the choices that were made in the selection of the artists for the website project, it emerges that a lot of emphasis was put on works that privileged an artistic approach over a technological one. Particular value was given to an approach that presented a critical and even subversive position towards the technologies used. From the analysis of the presentation of the works and their integration in the main exhibition curated by Catherine David, it appears that the artistic director considered the participation of media artists at documenta to be important, nevertheless she affirmed very clearly that works should not be divided by techniques and that the works of computer art created for the website should be integrated into the show. The presence of media work was furthermore supported by important sponsors that contributed financially and with technical backing to the realisation of the event. However, the website project and showroom was not directly curated by Catherine David, it was delegated to Simon Lamunière. Additionally, the showroom was conceived at the last moment and relegated to a place that the artists deemed inappropriate. No online connection was made available for works that needed it and the website was taken down at the end of the event. Furthermore, the invitation extended to media artists to engage with online works on the event's website that year was never repeated in the following editions of the event.

Analysis of the articles that appeared during the event shows that, although the exhibition in Kassel was sometimes criticised for being too inclined towards new technologies, the specific media art works of the website project, and in particular the work by Jodi, were positively received, even more so by the specialised press. The positive reaction of the press did not match the reaction of the artists who clearly

expressed their dissatisfaction concerning the presentation of their work, in particular the presentation in the physical spaces of the exhibition. Against the wishes of the artists, the decisions to display the works offline and to close the website after the show, suggest that there was a lack of dialogue or agreement between the artists involved and the curator. However, although it is difficult to directly associate the career of the artists to their participation at documenta X, it is evident that Jodi developed a very successful career in the following years, as has been illustrated in the preceding section. Jodi rapidly established themselves as pioneers and leading artists working with computers and the Internet.

From the previous observations, we can conclude that the subversive drive that fuelled Jodi's approach in the use of computer and internet, was not only the aspect that determined their selection to participate in an important event such as documenta, but also what determined their positive reception in the press and what later contributed to their successful career. Furthermore, the analysis of Jodi's participation in the documenta exhibition allows for more general considerations regarding the controversial relationship between new media art and the traditional field of established contemporary art institutions to be inferred. Although artistic experiments with new technologies were not an invention of the nineties, it is during these years that new media art was clearly recognised as a specific approach. Geert Lovink discerns the beginning of media art as early as the late eighties: "Despite its numerous predecessors and prehistories of telematic art, I see the late 1980s as a starting point when new media art hit the surface, specifically tied to the rise of desktop publishing, hypertext, and the production of CD-ROMs".[379]. New media art was not simply associated with the use of technologies but was identified as an artistic approach that offered a position, a comment on these technologies, in particular information technologies. As the documenta case confirms, artists that proposed a critical, subversive approach were privileged by curators and critics who identified their work as being representative of the emerging media art scene. This hypothesis is sustained by some of the leading critics and curators who, at the turn of the millennium, strongly determined the

[379] Geert Lovink, *Zero Comments: Blogging and Critical Internet Culture* (New York: Routledge 2008), 41.

association of new media with strategies such as hacktivism, tactical media and critical approaches.[380]

documenta X marked an important moment in the history of computer and digital art, a moment in which artists overtly manifested a critical position toward information technologies and rather misused them in their work. This peculiar subversive drive that played a role in the success of media artists and opened to them the door to important and international venues, nevertheless, contributed at the same time to the formation of a specific field, characterised by dedicated institutions, prizes, festivals, critics and curators that strengthened their specificity with regard to the traditional art world.

[380] See, for example: Inke Arns, *Netzkulturen im postoptischen Zeitalter* (Hamburg: Europ. Verl.-Anst, 2002); and: Christiane Paul, *Digital Art* (New York : Thames & Hudson, 2003).

Conclusion

The Myth of the Two Cultures

In 1971, Herbert W. Franke published an essay on computer art that has been widely mentioned in publications concerning this kind of artistic production and considered among the first comprehensive analysis of the genre. In the conclusion, he argued that computer art plays a fundamental role in our society by facilitating the dialogue between the arts and the sciences: in his words, computer art "has clarified the interactions between art, technology and science unlike any other medium before".[381] Writing in 1971, Franke predicted that in the decades to come, computer art would merge with the traditional world of art and eventually become the most important artistic medium. Forty years later, in his essay presenting and discussing the history of computer art, Grant D. Taylor laments the fact that this form of production is mostly ignored and rejected by the traditional art field.[382] According to Taylor, the reasons for this situation can be attributed to the persistent association of computer art with the cult of machines and new technologies, a fascination disdained by the humanities. However, in his narrative encompassing fifty years of artistic production, Taylor does not provide the arguments to contradict the association between computer-generated art and the techno-utopia ideology. Quite the opposite: he reaffirms Herbert Franke's credo that computer, digital and media arts are truly capable of bridging the gap between the humanities and the sciences - in reference to the famous separation between the two cultures discussed by Charles Percy Snow[383] - thus inviting traditional art historians, critics and curators to finally appreciate this important contribution to mankind. The compelling metaphor of 'bridging the two cultures', as a way to value the significance of this artistic production, has been a persuasive and recurring image employed by the

[381] "die Wechselwirkung zwischen Kunst, Technik und Wissenschaft verdeutlicht hat wie kein Medium zuvor", Herbert W. Franke, *Computergraphik, Computerkunst* (München: Bruckmann, 1971), 123, my translation from the German.

[382] Grant D. Taylor, *When the Machine Made Art: The Troubled History of Computer Art* (New York: Bloomsbury Academic, 2014).

[383] C. P. Snow, *The Two Cultures* (New York: Cambridge University Press, 1998).

most influential media art critics and historians, as I have observed in the analysis of the varied narratives offered to approach computer-generated art in the first chapter.

I believe that the use of the metaphor of 'bridging the two cultures' to address computer generated, digital and media art is inappropriate and misleading. According to my findings, the driving force behind this production, the purpose of the artists and their contribution to art and the society, have very little to do with the ambition of bringing the humanities and the sciences closer to one another. I am also convinced that this metaphor prevents this specific production from being correctly appreciated by the larger majority of art historians and curators. Furthermore, I argue that computer art has never been completely separated from the so-called traditional art world - which allows for the co-existence of dedicated fields - and that this perceived separation has to be understood in different terms than the one provided by the majority of critics who examined the supposed digital divide.

Before developing my arguments further, let us first consider an illustrative example within the field of media art: the presence of Anonymous at the Transmediale festival in Berlin in 2012. During the panel "Anonymous Codes: Disruption, Virality and the Lulz" (chaired by journalist Krystian Woznicki and featuring presentations by Gabriella Coleman, Jacob Appelbaum and Dana Buchzik) a member of the Anonymous movement appeared as a special guest via a live broadcast interview. The projected appearance of the spokesperson on the large screen behind the panel, hidden behind the iconic Guy Fawkes mask and addressing the audience with a disguised voice, was in itself quite impressive, but even more so were the arguments put forward to describe and justify the movement. While arguing that Anonymous aims at strengthening freedom and democracy, in particular by fighting against the censorship of the internet, the spokesperson affirmed that the movement does not follow a political agenda nor does it comply with a specific ideology. What is more, he claimed that everyone is part of Anonymous and that everyone is entitled to initiate action within the community, because the movement is not centralized. I had the chance to put a question to the spokesperson about the criteria concerning the selection of the actions proposed by the members of the community, and whether he considered the absence of a political

agenda upon which the members could discuss and agree as a hindrance to acting democratically in the long term. The answer wasn't unexpected: because of its very nature as a diaspora of unidentified individuals acting independently, Anonymous could not possibly function other than as a decentralized and apolitical movement. The sole unifying vision of the movement, conceded by the spokesperson, was the fight for the freedom of the internet worldwide. This response is coherent to the analysis of the movement made by anthropologist Gabriella Colemann.[384] According to her investigation, the movement was primarily motivated to carry out their actions simply "for the lulz", which in internet slangs stands for 'having fun'.[385] It is only with the collaboration with WikiLeaks, that a section of the movement became more engaged in political actions.[386] Nevertheless, Colemann acknowledges that the movement had a disruptive force and played a significant role in the Occupy movement. But if Anonymous's apolitical vision is not entirely convincing, what were the reasons behind the Transmediale Festival's decision to host a panel dedicated to the movement, other than the obvious purpose of discussing recent media buzz? The published outlet of the symposium presents the topic in the following terms: "mixing up with contemporary social media culture, being anonymous means to produce a new aesthetics - new linguistic codes - where poetic images, disruptive strategies (such as trolling and DDoSing) intertwine with multiple possibilities for lulz and pleasure".[387] The Transmediale Festival's interest in the activities of Anonymous hence relies mostly on its capability to propose 'new aesthetics' and entertainment, rather than on its political discourse, let alone the opportunity to bridge the two cultures.

The interest in hacking and cyberactivism is reflected in other important international media art festivals in recent years. Julian Assange, for example, was invited to present a Special Keynote at the 19th International Symposium on Electronic Art held in Sydney in 2013. During the talk, Assange discussed the activities of WikiLeaks and invited

[384] Gabriella Coleman, *Anonymous in Context: The Politics and Power Behind the Mask* (Waterloo, Ontario: The Centre for International Governance Innovation, Beaconsfield, Quebec: Canadian Electronic Library, 2013).
[385] The word 'lulz' is a stylised form of lols, plural of lol, abbreviation of 'laughing out loud'.
[386] See, for example, Stefania Milan, "WikiLeaks, Anonymous, and the Exercise of Individuality: Protesting in the Cloud" in *Beyond WikiLeaks : implications for the future of communications, journalism and society* (New York : Palgrave Macmillan, 2013), 191-208.
[387] *Transmediale 2k+12 Festival Catalogue - Day Planner* (Berlin: Kulturprojekte Berlin GmbH, 2012), 40.

artists engaging with digital media to have an impact on society. In 2010, the Ars Electronica Festival in Linz focused on the topic of sustainability, naming its edition with the suggestive title "Repair". The festival presented symposiums with international guests invited to expose their visions on how the modern technologies could be hacked and exploited to create tools that can help to fight excessive waste production and pollution. It offered an exhibition of innovative do-it-yourself projects along with another presenting artists, such as Chris Jordan and Cornelia Hesse-Honegger, who take a critical stance on the impact of modern technologies on the environment. Quite significantly, the Golden Nica for the digital community category was attributed to the German hacker group Chaos Computer Club, a group that subscribes to the hacker ethic as described by Steven Levy, encouraging freedom of information and mistrust of the authorities.[388] After many years of engaging with topics displaying an art and science flavour, from artificial intelligence to life science, with its 2010 edition, the Ars Electronica festival affirmed the intent to change the perspective of its content and engage with more socially engaged topics offering a more critical perspective on science and technology. The Italian magazine Neural, another significant voice within the media art community established in 1993, covering exclusively media art and electronic music, is divided in three sections: Hacktivism, E-Music and New Media Art. It is quite remarkable, that the very first section of the publication is dedicated to hacktivism: this choice gives a strong identity to the magazine and clearly shows the intent to include this practice among the spectrum of subjects associated with digital creativity. In this case, the strategies of hacking and cyberactivism are not simply discussed as one among the possible topics for the understanding of the contemporary artistic production, they are regarded as an integral and indispensable part of the media art discussion itself. These examples suggest that the field of media art today favours disruptive strategies and technology criticism, rather than following the aspiration of bridging the humanities and the sciences.

Hacking and cyberactivism became prominent within the artistic production during the nineties (with artists like etoy, RTMark and the Yes Men), when the term new media art started to be adopted as an umbrella term to bring together artistic productions

[388] Steven Levy, *Hackers: heroes of the computer revolution* (Garden City, N.Y.: Anchor Press/Doubleday, 1984).

associated with the use of digital and information technologies, as proposed by Geert Lovink, who identifies "the late 1980s as a starting point when new media art hit the surface".[389] The computer art showroom presented at documenta X in 1997 reflects this particular turning point. Analysis of the selection process of the artists that participated in this event, clearly demonstrate that the confrontational approach of the artist versus the machine was an important aspect for the curator of the exhibition: the artists selected to participate in this exhibition were mainly chosen because of their rebellious and provocative attitude not only toward the computing machine, but also concerning the implementation of information technologies within the society. They were not selected because they displayed a profound understanding of computer languages and digital tools, nor because of their ambition to parallel the scientific research. The artists selected to represent computer art in the last documenta of the century, offered on the contrary a rather pessimistic view of machines and information technologies, as exemplified by the work of Jodi.

The analysis of the documenta case incites the hypothesis that the confrontational attitude to machines and technologies, which would constitute a distinctive feature of media art production after the nineties, was encouraged by the actors of the traditional institutions of art. Margot Lovejoy, in her historical survey of digital art, mentions the dilemma of artists working with new technologies, confronted by the critical stance of many cultural critics that "are averse to even recognizing their works" because "they so deeply distrust technology and the losses it will bring in the future that they often do not want to look at an art that uses it as a means of representation".[390] Both Lovejoy and Taylor pointed out that the humanities, including fine art historians and curators, always considered modern technologies, and in particularly computers, with a sceptical eye. Furthermore, the investigation of the positions of artists participating in the debate against the top-down methodology of the traditional artificial intelligence research, during the eighties and nineties, confirms that the discourse developed within the humanities supporting a critical stance against modern technologies and computers was mirrored in artistic production. As already advanced in the conclusion of the third

[389] Geert Lovink, Zero Comments: Blogging and Critical Internet Culture (New York: Routledge, 2008), 41.
[390] Margot Lovejoy, *Digital Currents: Art in the Electronic Age* (New York: Routledge, 2004), 273.

chapter, artificial intelligence has been strongly criticized by researchers, philosophers and artists alike, while the computing machine has often been regarded as a product of military research, on the one hand, and as an instrument of capitalism and its modern exploitation of labour, on the other. But it is not only the association with capitalism and military research that affected the artistic development within this production: the emergence of new scientific fields of research such as artificial life and embodied robotics, with a strong emphasis on the bottom-up approach, certainly contributed to discrediting artificial intelligence research as obsolete and uninteresting: the criticism moved by the partisans of the bottom-up approach against traditional artificial intelligence reiterated the idea that the latter was founded on an archaic vision of the cognitive properties of humans. With the passing of time, artificial intelligence and its emblematic instrument, the computer, have been observed with growing suspicion. Eventually, these unapologetic visions of the computing machine opened the way for the subversive approaches within digital and media art.

Cyberactivist strategies in art are not a singular occurrence restricted to the emergence of media art during the nineties: many recent works engage in similar practices. For example, *Google Will Eat Itself* (2005), the collaborative work by Paolo Cirio, Alessandro Ludovico and Ubermorgen, is an explicitly disruptive project that aims at eventually overthrowing Google Inc. by exploiting the financial mechanisms that generate its income, based on selling targeted advertisement spaces. The project consists of the acquisition of parts of the company's shares with the money generated by exploiting the AdSense program offered by Google, who pays percentages of its income to individuals accepting to host targeted ads on their websites. Italian artists Eva and Franco Mattes, working collectively under these pseudonyms, question the habits and the motivations of the individuals participating in peculiar digital communities, by infiltrating and corrupting the codes of the subcultures belonging to specific social networks and video-games. Their works *No Fun* (2010), *Reenactments* (2007-10) and *Freedome* (2010) involve the participation of the artists within the virtual communities. The performative work of Eva and Franco Mattes highlights the cynicism and the immorality pervading these virtual social playgrounds, suggesting that the social networks and online video-games do not offer a chance for a greater dialogue, but rather

further isolate the individuals. !Mediengruppe Bitnik, who are arguably among the most prominent artistic collective representing new media art in Switzerland, have turned hacking into their distinctive approach. Their works consist of interventions that question the violation of privacy allowed by modern technologies. Activities such as hijacking the surveillance cameras of the Zurich police force (*Militärstrasse 105*, 2009) and of a tube station in London (*Surveillance Chess*, 2012) brought the artistic collective to the public attention. In 2013, !Mediengruppe Bitnik succeeded in sending a package to Julian Assange, confined in the Ecuadorian embassy in London, using a hidden camera and built-in GPS to track its tortuous trip to its destination. Although the work intended to test the possibility of contacting a controversial and protected person such as Assange - and at the same time determine the existence of a surveillance system within the postal service - the work implicitly asserted the affiliation of the artistic group with the leader of WikiLeaks and the hacker ideology associated with the organisation. During his online talk at the ISEA Festival in Sydney, Julian Assange returned the favour by mentioning the work of the Swiss artists as an example of meaningful digital art.

The GLI.TC/H festival founded in Chicago in 2010 by artists Nick Briz, Evan Meaney, Rosa Menkman and Jon Satrom proposes a cluster of works that, more particularly, further develop the disorderly aesthetic that characterized the early works of the Net Art movement, such as the one by Jodi and Mark Napier, for example. These younger artists exploit glitches and errors to produce performances, software, videos and musical works that rely on the malfunctioning of computing machines. For instance, they create videos depicting the chaotic multiplication of icons and folders on a window desk, or musical and visual compositions generated by corrupted files. Instead of manifesting the will to develop sophisticated programs that employ the computational capabilities of the machines, they rather build upon and emphasize the dysfunctional occurrences of computers and software to create works that are formally surprising and fascinating. Although these younger artists do manifest a peculiar fetish for a disorderly aesthetic, which is undeniably captivating on a formal level, they nonetheless exalt the vulnerability and uselessness of the machine, instead of its utility for society. Artist and musician Rosa Menkman, in particular, provided a theoretical discourse for the

development of glitch art as a genre and made it very clear that the artistic intent behind her work was indeed subversive in nature:

> To some artists, myself included, it has become a personal matter to break the assured informatic flows of media. (...) Through these tactics, glitch artists reveal the machine's techné and enable critical sensory experience to take place around materials, ideologies and (aesthetic) structures. Their destructive or disfiguring processes have no technological name, definition or explanation (yet).391

The words of Rosa Menkman, representing the youngest generation within a larger history of computer-based generative art, summarise quite well the convoluted stance regarding the machine that characterizes this type of artistic production: if on the one hand the glitch artists still manifest a fascination for the machine and its peculiar formal qualities, on the other they have clearly assimilated the subversive drive that characterized artistic production at the end of the nineties. The purpose of her work, as she affirms, is to disrupt the flows of media, challenging the idea that information technologies are reliable tools and therefore questioning their utility for our society.

However, the inclination of artists to engage with machines with a disruptive approach is not only a consequence of the establishment of the new media art field. The analysis of the work of Harold Cohen and Edward Ihnatowicz, joined with the considerations of their respective positions through their writings, contradict the idea that they were simply mimicking the scientific research in their works. Both artists developed their own language and solutions, exploiting the computer to pursue their artistic goals. Harold Cohen did not question the machine and its impact on society; nevertheless, his purpose was not to bring the arts and the sciences closer, it was first and foremost an enquiry into the act of drawing, an enquiry driven by the conviction that the general understanding of art-making should be challenged. Edward Ihnatowicz, on the other hand, was persuaded that art and technology should move toward the same goal, as expressed in his writings. In this sense, the metaphor of bridging the two cultures could be justified to describe his work. However, he strongly disagreed with the methodology of artificial intelligence, the most prominent model of exploiting computers for epistemological goals during his time. One decade before the publication of the theories

[391] Rosa Menkman, *The Glitch Moment(um)* (Amsterdam: Institute of Network Cultures, 2011), 33.

of embodied robotics, he anticipated the same ideas concerning the possibilities of machines to evolve in an open environment. What is more, the *Senster*, his most spectacular achievement, should be regarded as the result of his personal obsessions for building a life-like creature in the tradition of automata. To consider Ihnatowicz as an artist fascinated with the scientific research of his time would be incorrect. It is true that Cohen and Ihnatowicz were sincerely attempting to examine emerging behaviours such as intelligence and creativity, by developing a personal and profound understanding of the technologies they used in their artistic production. Nevertheless, these artists clearly stated their distance from the scientific research of their time and repeatedly affirmed their artistic identity and autonomy. The fascination for the computing machine expressed by the two pioneers has to be therefore reconsidered under the light of the critique that they addressed to the artificial intelligence research. Critics and historians that have discussed their works have, in my opinion, overstated the association of the artists to this scientific discipline during and after their lifetime.

If computer-based generative art is often considered as a very restricted group of works that exemplify the marriage of art and science, artists working within this field seem to resist this kind of classification and rather have developed a confrontational approach to the machine, which was, ultimately, the source of the creative process of their work. In conclusion, I argue that the metaphor of bridging the arts and the science is a misleading approach in understanding this form of artistic production in particular and media art in general. I also affirm that, if on the one hand the subversive drives were particularly expected and encouraged by curators and critics of the 'traditional' art world during the nineties, artists that used computers have developed a personal and disruptive approach even before that time. The will to challenge the usual functioning of the machine characterized the production of artists engaged in experimenting with computers. These artists constantly affirmed their independence from scientific research. If media art critics and historians continue to insist that the interest of computer-generated art relies on the opportunities it offers to bring the arts and the sciences closer together, this kind of artistic production will never be fully understood and appreciated, neither from the actors of the media art field, nor from the ones of the traditional art world. A change of perspective is needed, in which artists using computers and new media are considered

for their respective and creatively subversive approach, rather than for their supposed role of bringing the sciences and the humanities closer to one another. What is more, the change of perspective regarding this type of artistic production allows us to better understand and finally overcome the so-called digital divide.

Another Take on the Digital Divide

The digital divide is a prevailing and ongoing debate among the new media art specialists. Grant Taylor, while considering recent examples of digital and media art as an evolution of computer art, affirms that this production is still separated from the traditional art world. Catherine Mason, in her analysis of the early years of British computer art, concludes that this field "has tended to be overlooked by mainstream art".[392] Concerning digital and media art in general, she also adds that "there is still some way to go before these are thoroughly integrated within museum culture".[393] Edward Shanken and Domenico Quaranta sustain that this production, generally discussed under the term 'media art', is excluded from the traditional circuit of art, providing several arguments to explain the divide, already discussed in the first chapter. I am arguing that the perceived digital divide is badly formulated and further increases the misunderstanding of an important part of the current artistic production. Firstly, it is important to clarify some of the terms and concepts involved in the debate about the digital divide. Computer art, digital art and new media art, or simply media art, are being used interchangeably and inconsistently. In the first chapter, I have discussed the different narratives that linked computer-generated art to one group of production. Computer art is related to the artistic production involving the use of a general-purpose programmable machine. Digital art involves the use of digital media, and is often used as a synonym for computer art. The most recent term of media art, today widely used, encompasses a larger spectrum of works exploiting media ranging from computers to bio-technologies, including obsolete devices and tools. Although I have focused on computer-generated art in my research, I consider it as an exemplary case to discuss the

[392] Catherine Mason, *A Computer in the Art Room: The Origins of British Computer Arts 1950-80* (Hindrigham, Norfolk: JJG, 2008), 239.
[393] Ibid., 243.

so-called digital divide that concerns the supposed separation of the media art field from the traditional art field. This perceived divide is not to be confused with the separation of the two cultures, the humanities and the sciences, as expressed by Charles Percy Snow. The digital divide concerns the alleged separation between the traditional circuit of contemporary art and the field of new media art. I do not question the existence of the media art field: it is undeniable, that there are institutions, exhibitions, festivals and journals dedicated to present, promote and discuss artistic productions that focus on the use of digital media and modern technologies. I do not question that there are critics, curators and artists that work and evolve within this field. But to acknowledge the existence of one particular field does not necessarily imply that the field is separated from another. Contemporary art, on an international level, is composed of a large number of actors and overlapping fields. Photography, installation and video art, for example, are being discussed and promoted by dedicated institutions, journals and curators. Although they constitute specific fields, they are nevertheless all part of the contemporary art field. The same is true for media art. However, what the media art critics who discuss the digital divide affirm is that media art suffers from a particular reclusion, compared to other artistic productions, from the traditional and international fine art institutions. They deplore the lack of opportunities for media artists to participate and succeed in the traditional circuit of institutions, museums, biennales and commercial galleries that constitute the contemporary art world. It is precisely against this opinion and the arguments provided to support it, that I argue.

The discussion concerning the so-called digital divide is certainly complicated by the difficulty of clearly circumscribing the artistic production associated with media art. The coexistence of terms such as computer and digital art, as well as the recurring addition of the adjective 'new' - as in 'new media art' - further complicates the issue, because of the rapid evolution of new technologies. If the terms were used to only identify the artistic production with regard to the devices used by the artists, as I have previously described, the problem would be easily solved. However, prominent media art critics and historians such as Christiane Paul, Geert Lovink, Anke Hoffmann and Yvonne Volkart almost unanimously propose to identify media art with the works of artists who develop a personal reflection on the impact of media and digital

technologies on our society, rather than with respect to the media used in their practice. This is what I would call the thematic definition of media art, as opposed to the description based on the nature of the media used.

At first glance, the thematic definition offers the advantage of dissociating media art from modern technologies and, at the same time, including a wider range of works within this artistic production. In truth, the thematic definition allows works of media art to be arbitrarily included and excluded depending on the necessity of the critic or historian to justify his or her arguments. For example, media art critics that discuss the digital divide, support this thesis by excluding works of computer and digital art that are presented in the traditional circuit because, as they affirm, these works do not discuss the technologies employed by the artist, as requested by the thematic definition of media art. Claire Bishop affirmed that there are very few digital and new media artworks in the traditional art field, while Domenico Quaranta relates the history of media art and its flirt with contemporary art as a short lived adventure. If we consider recent important international exhibitions, it appears that works using computer and digital media are nevertheless included. The 13th documenta edition in 2012 presented a large retrospective of the works of Erkki Kurenniemi, an iconic figure of electronic music, experimental movies and robotics, while the 55th edition of the Venice Biennial in 2013 recreated a video-drome work by Stan Van Der Beek. If those might be regarded as historical tributes to pioneering artists engaging with computers, electronics and new media, they contradict or at least weaken the assumption that media art is cut off from the traditional circuit. Many contemporary artists that use computers and digital media in their practices, such as Cory Arcangel and Wade Guyton, are in fact often exhibited in important international institutions and exhibitions. It is therefore not the case that new media and digital art is not presented in the contemporary art circuit. What is nonetheless the case, is that artists who do work with new media and digital technologies and do exhibit within the traditional art circuit are systematically regarded as not being genuine media artists from the majority of critics who support the existence of the digital divide. According to Grant Taylor, many young contemporary artists, including Wade Guyton, "who employ digital technologies in their practice rarely make

references to computers."[394] Analogously, Claire Bishop affirms that many artists such as Cory Arcangel, Cao Fei and Miltos Manetas, who manifestly use digital media, do not bring these media into a critical and deeper perspective.

> While many artists *use* digital technology, how many really confront the question of what it means to think, see, and filter affect through the digital? How many *thematize* this, or reflect deeply on how we experience, and are altered by, the digitization of our existence?[395]

Bishop answers her own question by affirming that she can think of only a handful of artists undertaking these tasks, such as Frances Stark, Thomas Hirschhorn and Ryan Trecartin. Conversely, media art historians today still describe Harold Cohen as an artist who has not been correctly recognised by the traditional field. However, during his pioneering years, he exhibited in important institutions such as the Tate Modern in London, the San Francisco Museum of Modern Art and the Stedelijk Museum in Amsterdam.

It is clear from these examples, that the thematic argument allows for the exclusion of works of media art that are successful in the traditional art world because they would otherwise contradict the thesis that computer art is ignored by the traditional circuit. This points us to the fact that the concept of media art is employed not to define a specific group of artists or works, but primarily in order to claim, instead of defending, a specific field of practice. In this sense, I consider the thematic definition to be problematic. What is more, the thematic definition is another case of fallacy concerning medium specificity in art, as discussed by Rosalind Krauss in her essay *A Voyage in the North Sea*.[396] The American art historian refers to the work of Marcel Broodthaers (in particular his complex and evolving project *Musée d'Art Moderne, Département des Aigles*) to controvert the idea that works of art should be analysed and judged according to their conformity to the specificity of the medium employed, as defended by modernist critic Clement Greenberg. Although media art critics that support the thematic definition do not offer, strictly speaking, a Greenbergian definition of media

---

[394] Grant D. Taylor, *When the Machine Made Art: The Troubled History of Computer Art* (New York: Bloomsbury Academic, 2014), 1.
[395] Claire Bishop, "Digital Divide: Contemporary Art And New Media", *Artforum,* September 2012, 436.
[396] Rosalind E Krauss, *A Voyage on the North Sea: Art in the Age of the Post-Medium Condition* (New York, N.Y: Thames & Hudson, 2000).

specificity - that is to say, they do not affirm that the peculiar device used by the artist has to be employed in its physical specificity - they still fall prey to the fallacy, in my opinion, of attempting to impose a prescriptive definition of what media art should be, in this case based on the discourse offered by the artist. In the best case, the thematic definition can be accepted as an attempt to provide a qualitative criterion for the judgment of media art, upon which one might agree or disagree. In this case, works of media art that offer a reflection on modern technologies and their consequences on our society could be appreciated according to the significance of the discourse proposed by the artist. However, the thematic definition is not acceptable when determining the inclusion or exclusion of media art works within this kind of artistic production because it does not provide any reliable and objective criteria. It is an illusion that one could define the necessary content of media artworks. Similarly, it would be improbable to have content-based prescriptions for a painting, a work of photography or a drawing before accepting these artworks as such. The great majority of younger artists with whom I had the opportunity to discuss this issue, clearly considers themselves first and foremost as artists and are quite reluctant to subscribe to a specific field of art, be it computer art, digital art or media art. But the same is true for key figures: as already discussed, Harold Cohen explicitly refused to be considered a computer artist in his paper "Off The Shelf".[397] Christa Sommerer expressed a similar stance: although conceding to profit from the existence of an 'art and science' interest, she felt compelled to claim her artistic position and to express distance from any scientific goals or approaches, rooting her production in a larger artistic legacy, encompassing, for example, performance art.[398] Dirk Paesmans and Joan Heemskerk, of Jodi, strongly criticised the presentation of their work during the tenth documenta and in particular the constitution of an isolated showroom for media art. They also affirmed that they "never choose to be net.artists or not" but simply started, as artists, "to make things on the computer".[399] What is more, the discourses developed by these artists are very diverse, as demonstrated by the analysis of their work, and cannot be reduced under the restricting perspective of thematising the technologies in our society.

[397] Harold Cohen, "Off The Shelf", *The Visual Computer* 3, no. 86 (1986).
[398] Christa Sommerer, interview with the author in Linz, 3 June 2011.
[399] "Interview with Jodi", posted by rhizome May 19 2001, http://rhizome.org/discuss/view/29955/.

It appears to me that, when critics and historians attempt to define media art through the content of the works, they are in fact securing their artistic field by prescribing the necessary knowledge required to participate in it. In this sense media art could be considered a combat term. The reflection offered by Mitchell G. Ash on the word Pseudowissenschaft might be helpful here. Mitchell G. Ash considers the word Pseudowissenschaft as a combat term, which does not provide a clear characterization of the disciplines to which it refers, but is rather used to position the person employing the term within a debate "whose content is determined more by the interests of the actors involved than by durable and definable standards."[400] Analogously, the thematic definition of media art offers less the opportunity to better define media art, and rather secures the position of the actor discussing media art as an expert of the field. In this case, of course, the combat term does not have a negative connotation, such as 'Pseudowissenschaft', but a positive one. The mechanism is similar nonetheless.

The understanding of the thematic definition of media art as a case of medium specificity fallacy allows for better understanding of the question concerning the supposed digital divide. The most frequently recurring arguments offered to explain the divide, as analysed in the first chapter, invoke the lack of a commercial market within the art world and the lack of competences among critics and curators. I will not discuss the argument concerning the lack of market, since it goes beyond the content of my research. My experience in the traditional circuit of art as a curator, and having worked for an international commercial gallery in Geneva over the course of two years, has provided me with many convincing examples of the vast potential to commercialize a work of art regardless of its medium and form. After all, Yves Klein managed to sell for gold several "Zone de Sensibilité Picturale Immatérielle" in the early sixties! Furthermore, in his analysis of Internet art, Julian Stallabrass mentions examples of artists selling their works in a variety of ways. Although he concedes that the marketing of online works comes with many challenges associated with authorship and ownership, he asserts that "for online activists, perhaps the most pernicious aspect of showing

[400] "deren Inhalte weniger durch überzeitlich festlegbare Normen denn durch die jeweiligen Interessen der Akteure bestimmt wird", Mitchell G. Ash, "Pseudowissenschaft als historische Grösse" in *Pseudowissenschaft: Konzeptionen Von Nichtwissenschaftlichkeit in Der Wissenschaftsgeschicht*, ed. by Dirk Rupnow (Frankfurt am Main: Suhrkamp, 2008), 451, my translation from the German.

Internet art in the gallery is that it becomes unambiguously art."[401] On the other hand, the argument invoking the lack of knowledge from the traditional art critics and curators, regarding digital art, is emblematic of the ambivalence of the discourse provided by media art critics and curators. On the one hand, they deplore a supposed separation of fields, yet on the other, they insist that actors from the so-called traditional art field lack the instruments to understand digital art. It seems to me that this argument is precisely related to the medium specificity fallacy and the securing of the media art field by the actors involved with it. By defining media art works in regard to their supposed thematic-wise specificity and by affirming that knowledge in the field is required to approach such works, the actors working in the media art field not only establish the existence of their field and secure their positions, but they also exclude critics and curators of the traditional art field from discussing and participating in this form of artistic production. Digital and media artworks are undeniably present in the traditional circuit of fine arts, although I can concede that one might argue about their lower number in relation to the number of works using more traditional media, such as painting. However, the smaller proportion of computer artworks with respect to paintings and sculptures within the traditional circuit of art museums and galleries could be simply explained as a reduced number of artists working with this media, which leads to a lower number of convincing and exhibition worthy works. Media art critics insist that digital artworks presented in the traditional circuit differ from authentic media artworks, relying on the thematic definition. However, the differences based on the thematic definition between works of digital art presented in the traditional circuit and those which are allegedly excluded from it, as suggested by the supporter of the digital divide, are not convincing. The analysis of the criteria of selection and of the reception of the works of the tenth documenta demonstrates that the critical stance regarding modern technologies rather favoured the inclusion of computer-based works within a traditional institution.

As an alternative to the widespread idea that the mainstream art field excludes new media artworks and artists, I propose to consider that the perceived exclusion is in fact the result of the establishment of the media art field itself. As a separated field, media

[401] Julian Stallabrass, *Internet Art: The Online Clash of Culture and Commerce* (London: Tate Pub, 2003), 128.

art stands out and flourishes with its circuit of international festivals and dedicated institutions, it offers an important platform to artists, curators and critics (who focus on media and digital technologies) who, in turn, strengthen the field and its identity. Because it is a dedicated platform, it is more accessible for the concerned actors, than the wider circuit of traditional galleries and museums, which encompasses all contemporary artistic production. Certainly, a successful career within the new media art field doesn't automatically translate to a successful career in the contemporary art world. This is, I concede, a possible difficulty resulting in the existence of a dedicated field such as media art. Nonetheless, many artists have been able to present their works both in the specialised media art institutions and in the traditional ones as well. Julius von Bismarck, winner in 2008 of the prestigious Golden Nica award at the Ars Electronica Festival with his *Image Fulgurator,* later worked with other contemporary artists and institutions. For example, he collaborated with Santiago Sierra in the performative work *NO projected above the Pope* during the World Youth Day in Madrid in 2011 and he presented his works in traditional institutions such as the Palais de Tokyo and the Venice Biennial. Previously discussed artists like Jodi and !Mediengruppe Bitnik provide similar examples. Hence, digital and media art specialists need to abandon the illusion of medium specificity and forget the thematic definition of media art. In addition, freeing the work of digital and media art from their constrained role of 'bridging the two cultures', as I have already stated, will not only allow for a better appreciation of the qualities of these works, but will also constitute a valuable step towards the facilitation of a dialogue between the specialised field of media art and the traditional circuit of contemporary art.

The investigation of the origins of the subversive drives in computer-generated art has changed my initial assumptions concerning this type of artistic production. It now appears clear to me that these driving forces are a necessity of the artists engaging with machines to affirm their artistic work independently from the association with modern technologies and scientific research. My analysis also allowed me to approach the much debated questions of the digital divide. On several occasions, I had the opportunity to discuss the future of media art with artists, critics and curators involved in and outside of this field. I have always been surprised when someone expressed his or her

conviction that media and digital art is either doomed to disappear or else to eventually merge with the contemporary art world. These predictions bear a similar flavour to the ones that announced the end of painting some decades ago. They also strengthen the illusion of a digital divide. The abundance and the variety of this kind of artistic production today contradict such predictions, just as the vivacity of contemporary painting confirms, if needed, that this traditional medium is far from being depleted. The future of computer-based generative art, like that of media art in general, lies not in the merging with the traditional circuit of art, for these works and their artists have always been part of contemporary artistic production. The parallel existence of dedicated institutions for media art does not contradict this assertion. These institutions fulfil an important function by supporting artistic productions related to new media and modern technologies, as long as they allow works to be presented and discussed regardless of their supposed medium specificity. Critics and curators engaging with computer, digital and media art should learn to appreciate these types of productions for their artistic qualities, rather than focusing only on modern technologies as a topic and as a celebration of a supposed marriage between the arts and the sciences.

Bibliography

Annunziato, Mauro and Piero Pierucci. "Relazioni Emergenti: Experiments with the Art of Emergence." *Leonardo* 35, no. 2 (2002): 147-152.

Apter, Michael J. "Can Computers be Programmed to Appreciate Art?" *Leonardo* 10 (1977): 17-21.

Apter, Michael J. "Cybernetics and Art." *Leonardo* 2 (1969): 257-265.

Aristotle and David Bostock. *Aristotle Metaphysics: Books zeta and eta*. Oxford, England: Clarendon Press, 1994.

Arns, Inke. *Netzkulturen im postoptischen Zeitalter.* Hamburg: Europ. Verl.-Anst, 2002.

Ars electronica, Gerfried Stocker and Christine Schöpf. *Ars electronica 2005: hybrid - living in paradox*. Ostfildern-Ruit: Hatje Cantz, 2005.

Ars electronica, Gerfried Stocker and Christine Schöpf. *Memesis, the future of evolution*. Wien: New York, 1996.

Ars Electronica, Gerfried Stocker, and Christine Schöpf. *LifeScience*. Wien: Springer, 1999.

Ars Electronica, Karl Gerbel and Peter Weibel. *Genetische Kunst--künstliches Leben = Genetic art--artificial life*. Wien: PVS Verleger, 1993.

Art Futura 93: Barcelona, 22-24 April, 1993. Barcelona: Art Futura, 1993.

Art Futura 96: Robots & Knowbots. Barcelona: Art Futura, 1996.

Ascott, Roy. "La Plissure du texte." In *Art Telecommunication,* edited by Heidi Grundmann. Vancouver: A Western Front Publication, 1984.

Ascott, Roy. "Art and Telematics: Toward a Network Consciousness." In *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness*. Berkeley: Univ. of California Press, 2003. Originally published in *Art + Telecommunication*, ed. by Heidi Grundmann (Vancouver: Western Front, 1984).

Ascott, Roy. "*Gesamtdatenwerk*: Connectivity, Transformation, and Transcendence." In *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness*. Berkeley: Univ. of California Press, 2003. Originally published in *Kunstforum* 103 (1989).

Ash, Mitchell G. "Pseudowissenschaft als historische Grösse." In *Pseudowissenschaft: Konzeptionen Von Nichtwissenschaftlichkeit in Der Wissenschaftsgeschich*t, edited by Dirk Rupnow. Frankfurt am Main: Suhrkamp, 2008.

Asimo: Technical Information. Bangkok: Asian Honda Motor, 2007.

Bangert, Colette S. and Charles J. Bangert "Experiences in Making Drawings by Computer and by Hand." *Leonardo* 7 (1974): 289-296.

Banham, Reyner. "Arts in Society: Cap'n Kustow's toolshed." *New Society* 12, no. 208 (1968): 275-6.

Barbrook, Richard. "The Sacred Cyborg." *Telepolis* (10 September 1996). Accessed October 21, 2009. http://www.heise.de/tp/artikel/6/6063/1.htm.

Barbrook, Richard. *Imaginary Futures. From Thinking Machines to the Global Village*. London: Pluto Press, 2007.

Baumgärtel, Tilman. *Net.art 2.0: Neue Materialien Zur Netzkunst = New Materials Towards Net Art*. Nürnberg: Verlag für moderne Kunst, 2001.

Baumgärtel, Tilman. *Net.art: Materialien Zur Netzkunst*. Nürnberg: Verlag für moderne Kunst, 1999.

Becker, Barbara. "Cyborgs, Agents, and Transhumanists." *Leonardo* 33, no. 5 (2000).

Bense, Max. *Aesthetica: Einführung in Die Neue Aesthetik*. Baden-Baden: Agis-Verlag, 1965.

Benthall, Jonathan. "Computer arts at Edinburgh." *Studio International*, (October 1973).

Benthall, Jonathan. *Science and Technology in Art Today*. New York: Praeger Publishers, 1972.

Berkum, Ans and Tom Blekkenhorst, F. Blij. *Science [star] Art*. Utrecht, Neth: Fentener van Vissingen Fund, 1986.

Bishop, Claire. "Digital Divide: Contemporary Art and New Media." *Artforum* (September 2012): 434-441.

Bisig, Daniel and Adrianne Wortzel. "Narrative In Robotic Scenarios For Art Works." *Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts*. Hatfield, UK: The Society for the Study of Artificial Intelligence and the Simulation of Behaviour, 2005.

Blais, Joline and Jon Ippolito. *At the Edge of Art*. London: Thames & Hudson, 2006.

Boden, Margaret A. "Creativity and Computers." *Harold Cohen: The Tate Gallery [8 June - 24 July 1983]*. Millbank, London: Tate Gallery, 1983.

Boden, Margaret A. and Ernest A. Edmonds. "What is Generative Art?" *Digital Creativity* 20, no. 1-2 (2009).

Boden, Margaret A. *The Philosophy of Artificial Life*. Oxford: Oxford University Press, 1996.

Bourdieu, Pierre, "The Historical Genesis of a Pure Aesthetic." *The Field of Cultural Production: Essays on Art and Literature*. Cambridge: Polity Press, 1993.

Bourdieu, Pierre. "The Field of Cultural Production, or: The Economic World Reversed." *The Field of Cultural Production: Essays on Art and Literature*. Cambridge: Polity Press, 1993.

Bourdieu, Pierre. *Questions de sociologie*. Paris: Ed. de Minuit, 2002.

Brody, Florian and Mario Veitl. "ARTificial Intelligence & ARTificial ART." *Ars Electronica 1990, Digitale Träume virtuelle Welten.* Linz: Veritas-Verlag, 1990.

Brooks, Rodney A. "Elephants Don't Play Chess." *Robotics and Autonomous Systems 6.* Cambridge: MIT Artificial Intelligence Laboratory, 1990.

Brooks, Rodney A. *Cambrian intelligence. The Early History of the New AI.* Cambridge, Massachusetts; London, UK: The MIT Press, 1999.

Brooks, Rodney A. *Robot: The Future of Flesh and Maschines.* England, UK: Allen Lane, The Penguin Press, 2002.

Brooks, Rodney A. *The Artificial Life Route to Artificial Intelligence: Building Embodied, Situated Agents*. Hillsdale, New Jersey; Hove, UK: Lawrence Erlbaum Associates, 1995.

Brown, Paul "Emergent Behaviours; towards computational aesthetics." *Artlink* 16, Nos. 2-3 (1996).

Brown, Paul. "From Systems Art to Artificial Life: Early Generative Art at the Slade School of Fine Art." In *White Heat Cold Logic: British Computer Art 1960-1980,* edited by Paul Brown et al. Cambridge, Mass: MIT Press, 2008.

Brown, Paul. "The Idea Becomes a Machine: AI and A-Life in Early British Computer Arts." *Engineering Nature. Art & Consciousness in the Post-Biological Era*, edited by Roy Ascott. Bristol: Intellect, 2006.

Burnham, Jack W. "Art and Technology." In *Britannica Yearbook of Science and the Future*. Chicago: Encyclopaedia Britannica, 1972.

Burnham, Jack W. *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century*. New York: G. Braziller, 1968.

Burroughs, William S. and Brion Gysin. *The Third Mind* New York: Viking Press, 1978.

Cariani, Peter. "Emergence and Artificial Life."In *Artificial Life II: Proceedings of the Workshop on Artificial Life: Held February 1990 in Santa Fe, New Mexico*, edited by Christopher G. Langton, 775-796. Redwood City, Calif: Addison-Wesley, 1992.

Catts, Oron and Ionat Zurr "The Ethics of Experiential Engagement with the Manipulation of Life." In *Tactical Biopolitics: Art, Activism, and Technoscience*, edited by Beatriz Da Costa and Kavita Philip. Cambridge, Mass: MIT Press, 2008.

Chapuis, Alfred and Edmond Droz. *Les Automates. Figures Artificielles D'hommes Et D'animaux. Histoire Et Technique*. Neuchâtel: Éditions du Griffon, 1949.

Churchland, Paul M. and Patricia Smith Churchland. "Could A Machine Think?" *Scientific American* (January 1990): 32-37.

Clark, Andy and David J. Chalmers. "The Extended Mind." *Analysis* 58 (1998): 7-19.

Clarke, Bruce and Mark B N Hansen. *Emergence and Embodiment: New Essays on Second-Order Systems Theory.* Durham and London: Duke University Press, 2009.

Clarke, Bruce, and Linda D. Henderson. *From Energy to Information: Representation in Science and Technology, Art, and Literature*. Stanford, Calif: Stanford University Press, 2002.

Cohen, Harold, Becky Cohen, Penny Nii, and Edward A. Feigenbaum. *The First Artificial Intelligence Coloring Book: Art and Computers.* Los Altos, California: W. Kaufmann, 1984.

Cohen, Harold. "Colouring Without Seeing: a Problem in Machine Creativity." *AISB quarterly*, no. 102 (1999).

Cohen, Harold. "Driving the Creative Machine." Paper presented at the Orcas Crossroads Lecture Series, Eastsound, September 2010.

Cohen, Harold. "How to make a drawing." Paper presented at the Science Colloquium, National Bureau of Standards, Washington DC, December 17, 1982.

Cohen, Harold. "Off the Shelf." In *The Visual Computer* 3/86. Springer International, 1986.

Cohen, Harold. "On purpose. An enquiry into the possible roles of the computer in art." *Studio International* 187, no. 962 (1974).

Cohen, Harold. "Parallel to Perception: Some Notes on the Problem of Machine-Generated Art." In *Computer studies in the humanities and verbal behavior* IV. The Hague: Mouton, 1973.

Cohen, Harold. "The further exploits of Aaron, painter." *Stanford Humanities Review* 4, no. 2 (1995): 141-158.

Cohen, Harold. "The Material of Symbols." *New Wilderness Letter* 1, no. 1 (1977).

Cohen, Harold. "What is an Image?" *IJCAI-79: proceedings of the Sixth International Joint Conference on Artificial Intelligence, Tokyo, August 20-23, 1979, 1028-1057*. Los Altos, California: Distributed by William Kaufmann, Inc, 1979.

Cohen, Harold. "On the modelling of creative behavior." *The Rand paper series.* Santa Monica: Rand Corporation, 1981.

Cohen, Harold. "The Art of Self-Assembly: the Self-Assembly of Art." Paper presented at the Dagstuhl Seminar on Computational Creativity. *Computational Creativity: An Interdisciplinary Approach*. Schloss Dagstuhl: Leibniz-Zentrum fuer Informatik, July 2009.

Cohen, Harold. *On the Modelling of Creative Behavior*. Santa Monica, CA: The Rand Corporation, 1981.

Coleman, Gabriella. *Anonymous in Context: The Politics and Power Behind the Mask.* Waterloo, Ontario: The Centre for International Governance Innovation, Beaconsfield, Quebec: Canadian Electronic Library, 2013.

Costa, Mario. *New Technologies: Ascott, Bolognini, Forest, Kriesche, Mitropoulos.* Salerno: Artmedia, Università di Salerno, Dipartimento di filosofia, 2003.

Cox, G., A. McLean and A. Ward. "The Aesthetics of Generative Code." Paper presented at the *International Conference on Generative Art*, Milan, December 2000.

Coyne, Richard. *Technoromanticism. Digital Narrative, Holism, and the Romance of the Real*. Cambridge: The MIT Press, 1999.

Cramer, Florian. "DISCORDIA CONCORS: www.jodi.org." In *Install.exe - Jodi: [plug in] Kunst und neue Medien, Basel, 18. September bis 27. Oktober 2002*. Basel: Merian, 2002.

Crevier, Daniel. *AI: The Tumultuous History of the Search for Artificial Intelligence*. London and New York: Basic Books, 1993.

Culbertson, James T. *The Minds of Robots*. Illinois: Urbana, 1965.

D'Inverno, Mark and Jane Prophet. "Creative conflict in interdisciplinary collaboration." In *Interaction: Systems, Theory and Practice*, edited by Ernest Edmonds and Ross Gibson, 251-270. Broadway, N.S.W.: Creativity & Cognition Studios Press, University of Technology, 2004.

Da Costa, Beatriz and Kavita Philip. *Tactical biopolitics.* Cambridge, Mass.: MIT Press, 2008.

David, Catherine and Paul Sztulman. *documenta X: short guide = Kurzführer.* Ostfildern-Ruit: Cantz, 1997.

Dawkins, Richard. *The Selfish Gene.* New York: Oxford University Press, 2006.

De La Mettrie, Julien Offray. *L'homme Machine*. Paris: Henry, 1865.

Deinhard, Hanna. *Meaning and expression; toward a sociology of art*. Boston: Beacon Press, 1970.

Deleuze, Gilles. "Postscript on the Societies of Control." Translated by Martin Joughin. *October* no. 59 (1992): 3-7.

Demers, Louis-Philippe and Bill Vorn. "No Man's Land." In *Memesis: Die Zukunft Der Evolution = the Future of Evolution: Ars Electronica Festival 96, 2.-6.9.1996*. Linz: Ars Electronica, 1996.

Denton, John. *Put on your blue genes: BioTech-Kunst und die Verheissungen der Biotechnologie*. Berlin: Neue Gesellschaft für Bildende Kunst, 2005.

Diederichs, Joachim, and Manfred Schneckenburger. *Documenta 6: Kassel (24.6. - 2.10.1977)*. Kassel: Dierichs, 1977.

Dietrich, Frank. "The Computer: A Tool for Thought-Experiments." *Leonardo* 20, no. 4 (1987): 315-325.

documenta X www.documenta.de: documenta 10 Website. Kassel: documenta und Museum Fridericianum, 1997. CD-ROM.

Doron Swade. *Charles Babbage and His Calculating Engines*. London: Science Museum, 1991.

Doyon, André and Lucien Liaigre. *Jacques Vaucanson: Mécanicien De Génie.* Paris: Presses Universitaires de France, 1966).

Dreyfus, Hubert L. "Alchemy and Artificial Intelligence." In *Rand Corporation Paper*. Santa Monica: Rand Corp, 1964.

Dreyfus, Hubert L., Stuart E. Dreyfus and Tom Athanasiou. *Mind Over Machine: The Power of Human Intuition and Expertise in the Era of the Computer*. New York: Free Press, 1986.

Dyens, Ollivier. *Metal and Flesh. The Evolution of Man: Technology Takes Over*. Cambridge: The MIT Press, 2001.

Dyson, George. *Darwin Among the Machines: The Evolution of Global Intelligence*. Reading, Mass: Addison-Wesley Pub. Co, 1997.

Electra. L'électricité et l'électronique dans l'art au XXe siècle. MAM, Musée d'Art Moderne de la Ville de Paris, 1984.

Fahrer, Sigrid. *Cut-up: Eine Literarische Medienguerilla.* Wurzburg: Konigshausen & Neumann, 2009.

Feenberg, Andrew. *Alternative Modernity: The Technical Turn in Philosophy and Social Theory*. Berkeley: University of California Press, 1995.

Feingold, Ken. "The Subject of Artificial Intelligence." Paper presented at the *Art and Artificial Intelligence* seminar at the Royal University College of Fine Arts (KKH), Stockholm, Sweden, October 2002. Accessed 25 March 2009. http://www.kenfeingold.com/docs/The_Subject_of_AI.pdf.

Flake, Gary William. *The computational beauty of nature: computer explorations of fractals, chaos, complex systems, and adaption*. Cambridge, Mass.: MIT Press, 1999.

Flanagan, Mary. "Digital Stars are Here to Stay." In *Convergence: The Journal of Research into New Media Technologies* 5, no. 2 (1999): 16-21.

Flanagan, Mary. "The Bride Stripped Bare To Her Data: Information Flow + Digibodies." In *Data Made Flesh: Embodying Information*, edited by Robert Mitchell and Phillip Thurtle. New York: Routledge, 2004.

Forge, Andrew. "On Harold Cohen's Drawings." In *Harold Cohen, Drawing: San Francisco Museum of Modern Art, July 28-September 9, 1979*. San Francisco: San Francisco Museum of Modern Art, 1979.

Foster, Hal. *The anti-aesthetic: essays on postmodern culture*. Port Townsend, Wash.: Bay Press, 1983.

Foucault, Michel. *Naissance de la biopolitique: cours au Collège de France (1978-1979).* Paris: Gallimard - Seuil, 2004.

Franke, Herbert W. "A Cybernetic Approach to Aesthetics." *Leonardo* 10 (1977): 203-206.

Franke, Herbert W. "Computers and Visual Art." *Leonardo* 4 (1971): 331-338.

Franke, Herbert W. *Computergraphik, Computerkunst*. München: Bruckmann, 1971.

Frazer, John. *An Evolutionary Architecture*. London: Architectural Association, 1995.

Fritz, Sandy. *Understanding Artificial Intelligence*. New York: Warner Books, 2002.

Fukuyama, Francis. *Our Posthuman Future: Consequences of the Biotechnology Revolution*. New York: Farrar, Straus and Giroux, 2002.

Fuller, Matthew. *Media ecologies: Materialist energies in art and technoculture*. Cambridge, Mass.: MIT Press, 2005.

Galanter, Philip. "What is Generative Art? Complexity theory as a context for art theory." In *International Conference on Generative Art*. Milan: Generative Design Lab, Milan Polytechnic, 2003.

Galloway, David. "Die Muse in der Steckdose." *Kunstforum* 97 (1988): 86.

Gardner, James. *Elephants in the Attic: The Autobiography of James Gardner*. London: Orbis, 1983.

Gatti, Gianna Maria. *The Technological Herbarium*. Berlin: Avinus Verlag, 2010.

"Generative art is as old as art. An interview with Philip Galanter." *artificial.dk*, September 6, 2004. Accessed March 29, 2010. http://www.artificial.dk/articles/galanter.htm.

Gibbs, Samuel. "Google buys UK artificial intelligence startup Deepmind for £400m." *The Guardian,* January 27, 2014.

Goodyear, Anne C. "From Technophilia to Technophobia: the Impact of the Vietnam War on the Reception of 'Art and Technology'." *Leonardo* 41, no.2 (2008): 169-173.

Gramazio, Fabio and Matthias Kohler. *Digital Materiality in Architecture.* Baden: Müller, 2008.

Grau, Oliver. "History of Telepresence: Automat, Illusion, and Rejecting the Body." In *The robot in the garden: telerobotics and telepistemology in the age of the Internet*, edited by Ken Goldberg, 226-246. Cambridge, Mass.: MIT Press, 2000.

Grau, Oliver. *MediaArtHistories*. Cambridge, Mass: MIT Press, 2007.

Grau, Oliver. *Virtual Art: From Illusion to Immersion.* Cambridge, Mass: MIT, 2003.

Graw, Isabelle. "Man sieht, was man sieht. Anmerkungen zur Netzkunst." *Texte zur Kunst* (December 1998).

Halacy, D S. *Charles Babbage, Father of the Computer*. New York: Crowell-Collier Press, 1970.

Haraway, Donna. *Simians, Cyborgs and Women: The Reinvention of Nature*. New York: Routledge, 1991.

Hardt, Michael and Antonio Negri. *Empire*. Cambridge, Mass: Harvard University Press, 2000.

Harold Cohen - The Tate Gallery [8 June - 24 July 1983]. Millbank, London: Tate Gallery, 1983.

Harrison, Dew. "Mind Memory Mapping Metaphor: Is Hypermedia Cognitive Art?" In *Reframing Consciousness*, edited by Roy Ascott, 151-155. Exeter, England: Intellect, 1999.

Hassan, Ihab. *The postmodern turn: essays in postmodern theory and culture*. Columbus: Ohio State University Press, 1987.

Haugeland, John. *Artificial Intelligence: The Very Idea*. Cambridge: The MIT Press, 1985.

Hayles, Katherine. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago, Ill: University of Chicago Press, 1999.

Heidegger, Martin. "Die Frage nach der Technik." In *Vorträge und Aufsätze*. Pfullingen: Neske, 1954.

Heudin, Jean-Claude. *Les Créatures Artificielles: Des Automates Aux Mondes Virtuels*. Paris: O. Jacob, 2007.

Hoffmann, Anke and Andreas Broeckmann. *Connect. Kunst zwischen Medien und Wirklichkeit: eine ausstellung mit Medienkunstarbeiten des Sitemapping-Programmes (BAK) 2003-2011, Shedhalle Zürich 14. Juli-11. September 2011] = Connect. Art between Media and Reality*. Nürnberg: Verlag für moderne Kunst, 2011.

Huhtamo, Erkki and Jussi Parikka. *Media archaeology: approaches, applications, and implications.* Berkeley, Calif.: University of California Press, 2011.

Hultén, Pontus. *The Machine as seen at the end of the mechanical age*. New York: The Museum of Modern Art, 1968.

Huws, Ursula. "Nature, Technology and Art: The Emergence of a New Relationship?" *Leonardo* 33, no. 1 (2000): 33-40.

Ibn-Al-Razzaz Al-Jazari. *The Book of Knowledge of Ingenious Mechanical Devices*. Dordrecht: Reidel, 1974.

Ihnatowicz, Edward *Cybernetic Art: A Personal Statement*. Middlesex: E. Ihnatowicz, 1980.

Ihnatowicz, Edward *Portrait Of The Artist As An Engineer*. Unfinished and unpublished, published on the internet. Accessed February 3, 2009. http://www.senster.com/ihnatowicz/articles/index.htm).

Ihnatowicz, Edward. "Maggoty Intelligence." Unfinished and unpublished, published on the internet. Accessed February 3, 2009. http://www.senster.com/ihnatowicz/articles/index.htm.

Ihnatowicz, Edward. "The Relevance of Manipulation to the Process of Perception." *Bulletin of the Institute of Mathematics and its Applications* (May 1977): 133-135.

Ihnatowicz, Edward. "Towards a Thinking Machine", In *Artist and Computer*, edited by Ruth Leavitt, 32-34. New York: Harmony Books, 1976.

Ihnatowicz, Richard. "Forty Is a Dangerous Age: A Memoir of Edward Ihnatowicz." In *White Heat Cold Logic: British Computer Art 1960-1980*, edited by Paul Brown, 111-117. Cambridge: MIT Press. 2009.

Install.exe - Jodi: [plug in] Kunst und neue Medien, Basel, 18. September bis 27. Oktober 2002, edited by Tilman Baumgärtel and Annette Schindler. Basel: Merian, 2002.

Internatioanler Videokunstpreis 1998 = International award for video art 1998. Karlsruhe: Zentrum für Kunst und Medientechnologie, 1998.

Ippolita. *Luci E Ombre Di Google: Futuro E Passato Dell'industria Dei Metadati*. Milano: Feltrinelli, 2007.

Jaquet-Droz, Pierre. *Les Oeuvres Des Jaquet-Droz: Montres, Pendules Et Automates (Musées et collections privées)*. La Chaux-de-Fonds: Imprimerie Courvoisier, 1971.

Jaschko, Susanne "Process as aesthetic paradigm: a nonlinear observation of generative art." Paper presented at the *Generator.x* conference, 23 - 24. September 2005, Oslo, Atelier Nord. Accessed March 5, 2012. http://www.generatorx.no/20051115/text-process-as-aesthetic-paradigm-a-nonlinear-observation-of-generative-art/#more-312.

Julian Stallabrass. *Internet Art: The Online Clash of Culture and Commerce*. London: Tate Pub, 2003.

Kac, Eduardo. "Foundation and Development of Robotic Art." *Art Journal* 56, no. 3 (1997): 60-67.

Kim, Jaegwon. *Essays in the Metaphysics of Mind*. Oxford: Oxford University Press, 2010.

Kirnberger, Johann Philipp. *Der allezeit fertige Polonoisen- und Menuettencomponist.* Berlin: Christian Friedrich Winter, 1757.

Konstruiertes Leben = Constructed life. Szenarien der Fiktion zwischen Computergames, Cyber-Sex, Nanobytes, Robotic Arts. Internationaler Medienkunstpreis 2003. Karlsruhe: ZKM, 2003.

Krauss, Rosalind E. *A Voyage on the North Sea: Art in the Age of the Post-Medium Condition.* New York, N.Y: Thames & Hudson, 2000.

Kugel, Peter. "Artificial Intelligence and Visual Art." *Leonardo* 14, no. 2 (1981): 137-139.

Kultur Digital: Begriffe, Hintergründe, Beispiele, edited by Hedy Graber, Dominik Landwehr and Veronika Sellier. Basel: Merian, 2011.

Kuni, Verena. "Why I never became a net art historian." In *Net Pioneers 1.0: Contextualizing Early Net-Based Art,* edited by Dieter Daniels and Gunther Reisinger, 181-197. Berlin: Sternberg Press, 2009.

Kurzweil, Ray. *Are We Spiritual Machines? Ray Kurzweil Vs the Critics of Strong Al*. Seattle: Discovery Institute Press, 2002.

Kurzweil, Ray. *The Singularity Is Near: When Humans Transcend Biology*. London: Penguin Books, 2006.

Landers, Richard R. *Man's Place in the Dybosphere*. Englewood Cliffs N.J: Prentice-Hall, 1967.

Landwehr, Dominik and Verena Kuni. *Home Made Electronic Arts: Do-it-yourself-piratensender, Krachgeneratoren Und Videomaschinen = Do-It-Yourself Pirate Tv, Noise Generators, and Video Machines*. Switzerland: Migros-Kulturprozent, 2009.

Langton, Christopher G. "Artificial Life." In *Artificial Life: The Proceedings of an Interdisciplinary Workshop on the Synthesis and Simulation of Living Systems, Held September, 1987, in Los Alamos*. Redwood City, Calif: Addison-Wesley Pub. Co., Advanced Book Program, 1989.

Latour, Bruno. *Nous n'avons jamais été modernes: essai d'anthropologie symétrique*. Paris: Editions La Découverte, 1991.

Laughlin, Robert B. *A Different Universe. Reinventing Physics from the Bottom Down*. New York: Basic Books, 2005.

Law, Jane M. *Puppets of Nostalgia: The Life, Death, and Rebirth of the Japanese Awaji Ningyo Tradition*. Princeton, N.J: Princeton University Press, 1997.

Leopoldseder, Hannes and Christine Schöpf. *The Network for Art, Technology and Society: The First 30 Years Ars Electronica 1979-2009*. Ostfildern: Hatje Cantz, 2009.

Les robots rêvent-ils du printemps? Installations de Ken Rinaldo. Yverdon-les-Bains, Suisse: Maison d'Ailleurs, 2010.

Levy, Steven. *Hackers: heroes of the computer revolution*. Garden City, N.Y.: Anchor Press/Doubleday, 1984.

Lewes, G. Henry. *Problems of Life and Mind* London: Trübner, 1875.

Lexikon der Kunst. Leipzig: E.A. Seemann, 1987-1994.

Lintermann, Bernd and Oliver Deussen. *Digital Design of Nature.* Berlin: Springer, 2005.

Lovejoy, Margot. *Digital Currents: Art in the Electronic Age.* New York: Routledge, 2004.

Lovink, Geert. "New Media, Art and Science: Explorations beyond the Official Discourse." In *Empires, Ruins + Networks: The Transcultural Agenda in Art*, edited by Scott McQuire and Nikos Papastergiadis. London: Rivers Oram Publishers, 2005.

Lovink, Geert. *Zero Comments: Blogging and Critical Internet Culture*. New York: Routledge, 2008.

MacGowan, Roger and Frederick Ordway, *Intelligence in the Universe.* Englewood Cliffs NJ: Prentice-Hall, 1966.

Manovich, Lev. *The Language of New Media*. Cambridge, Mass: MIT Press, 2002.

Mapping New Territories: Schweizer Medienkunst International, Neue Kunst Halle St. Gallen, 30.01.2005-27.03.2005. Basel: Merian, 2005.

Marcuse, Herbert. *One-dimensional Man: Studies in the Ideology of Advanced Industrial Society*. Boston: Beacon Press, 1964.

Mason, Catherine. "The Routes toward British Computer Arts: The Role of Cultural Institutions in the Pioneering Period." In *White Heat Cold Logic: British Computer Art 1960-1980*, edited by Paul Brown, 245-264. Cambridge: MIT Press, 2009.

Mason, Catherine. *A Computer in the Art Room: The Origins of British Computer Arts 1950-80*. Hindrigham, Norfolk: JJG, 2008.

Maturana, Humberto R. and Francisco J. Varela *The Tree of Knowledge: The Biological Roots of Human Understanding.* Boston: Shambhala, 1992.

McCorduck, Pamela. *Aaron's Code. Meta-Art, Artificial intelligence, and the Work of Harold Cohen*. New York: W.H.Freeman & Company, 1990.

Menkman, Rosa *The Glitch Moment(um)*. Amsterdam: Institute of Network Cultures, 2011.

Michie, Donald and Rory Johnston. *The Creative Computer: Machine Intelligence and Human Knowledge.* Harmondsworth, Middlesex: Penguin, 1984.

Milan, Stefania. "WikiLeaks, Anonymous, and the Exercise of Individuality: Protesting in the Cloud." In *Beyond WikiLeaks: implications for the future of communications, journalism and society*, edited by by Benedetta Brevini, Arne Hintz and Patrick McCurdy, 191-208. New York: Palgrave Macmillan, 2013.

Mill, John S. *The Collected Works of John Stuart Mill, Volume VII - A System of Logic Ratiocinative and Inductive, Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation (Books I-III)*. Toronto: University of Toronto Press, 1963.

Minsky, Marvin L. "Steps Toward Artificial Intelligence." In *Computers and Thought*, edited by Edward A. Feigenbaum and Julian Feldman, 406-450. (New York: McGraw-Hill, 1963).

Minsky, Marvin L. "Why People think Computers can't." *AI Magazine* 3, no. 4 (1982): 3-15.

Minsky, Marvin L. *The Emotion Machine: Commonsense Thinking. Artificial Intelligence and the Future of the Human Mind*. New York: Simon & Schuster, 2006.

Minsky, Marvin L. *The Society of Mind.* New York: Simon and Schuster, 1986.

Monro, Gordon. "Emergence and Generative Art," *Leonardo* 42, no. 5 (2009): 476-477.

Moravec, Hans P. *Mind Children: The Future of Robot and Human Intelligence*. Cambridge, Mass: Harvard University Press, 1988.

Morozov, Evgeny. *The Net Delusion: How Not to Liberate the World*. London: Allen Lane, 2011.

Morgan, C L. "Emergent Evolution: The Gifford Lectures." Paper presented at the University of St. Andrews, 1922. London: Williams and Norgate, 1923.

Mumford, Lewis *The Myth of the Machine.* New York: Harcourt, Brace & World, 1967.

Mundy, Jennifer. *Lost Art: Missing Artworks of the Twentieth Century*. London: Tate Publishing, 2013.

Negroponte, Nicholas. *The Architecture Machine: Toward a More Human Environment.* Cambridge, Mass: The MIT Press, 1970.

Nelkin, Dorothy and Suzanne Anker *The molecular gaze: art in the genetic age.* New York: Cold Spring Harbor Laboratory Press, 2003.

Nierhaus, Gerhard. *Algorithmic Composition: Paradigms of Automated Music Generation*. Wien: Springer, 2009.

Parachute (Corps Automates/Automata), no. 112 (2003).

Parachute (Extra Human AI), no. 119 (2005).

Parachute (Extra Human SC), no. 121 (2006).

Paul, Christiane and Erkki Huhtamo. *Second natures: faculty exhibition of the UCLA Design/Media Arts department, Eli & Edythe Broad Arts Center*. Los Angeles, CA: Regents of the University of California, 2006.

Paul, Christiane. *Digital Art.* London: Thames & Hudson, 2003.

Paul, Christiane. *New Media in the White Cube and Beyond: Curatorial Models for Digital Art*. Berkeley: University of California Press, 2008.

Pearson, Matt. *Generative Art: A Practical Guide Using Processing*. Shelter Island, NY: Manning, 2011.

Penny, Simon, "Twenty years of artificial life art'." *Digital Creativity* 21, no.3 (2010): 197-204.

Penny, Simon. "Bridging Two Cultures: Towards an Interdisciplinary History of the Artist-Inventor and the Machine-Artwork." In *Artists As Inventors, Inventors As Artists,* edited by Dieter Daniels and Barbara U. Schmidt, 142-157. Ostfildern, Germany: Hatje Cantz, 2008.

Penny, Simon. "The Darwin Machine: Artificial Life and Interactive Art." *New Formations,* no. 29 (1996): 59-68.

Pepperell, Robert. "Towards a Conscious Art." In *Engineering Nature. Art & Consciousness in the Post-Biological Era*, edited by Roy Ascott, 11-16. Bristol: Intellect, 2006.

Perregaux, Charles. *Les Jaquet-Droz et Leschot*. Neuchâtel: Attinger, 1916.

Petersen, Thomas. "Special: Generative art." *artificial.dk*, June 9, 2004. Accessed February 2, 2012. http://www.artificial.dk/articles/generativespecial.htm.

Pickering, Andrew. *The Cybernetic Brain: Sketches of Another Future.* Chicago: University of Chicago Press, 2010.

Popper, Frank. *From Technological to Virtual Art.* Cambridge, Mass: MIT Press, 2007.

Postman, Neil. *Technopoly: the surrender of culture to technology*. New York: Knopf, 1992.

Powell, Herbert F. "Machines That Think." *Popular Science Monthly*, January (1928): 12-13.

Prophet, Jane. "Sublime Ecologies and Artistic Endeavors: Artificial Life and Interactivity in the Online Project 'technosphere'." *Leonardo* 29, no. 5 (1996): 339-344.

Punt, Michael. "Editorial: Human Consciousness and the Postdigital Analogue." *Leonardo* 35, no. 2(2002): 119-120.

Quaranta, Domenico. *Media, New Media, Postmedia.* Milano: Postmedia books, 2010.

Ray, Thomas S. "An evolutionary approach to synthetic biology: Zen and the art of creating life." In *Artificial Life 1(1/2), 195-226.* Cambridge, Mass.: MIT Press, 1994.

Reas, Casey, Chandler McWilliams and Jeroen Barendse. *Form+code in Design, Art, and Architecture.* New York: Princeton Architectural Press, 2010.

Reichardt, Jasia *The computer in art.* London, New York: John Lewis, 1971.

Reichardt, Jasia. "Art at large." *New Scientist* 54, no. 794 (1972).

Reichardt, Jasia. *Cybernetic Serendipity: The Computer and the Arts: a Studio International Special Issue*. London: Published by Studio international, 1968.

Reichardt, Jasia. *Robots: Fact, Fiction, and Prediction.* New York: Viking Press, 1978.

Reichle, Ingeborg. *Art in the Age of Technoscience*. Wien: Springer-Verlag, 2009.

Rinaldo, Kenneth E. "Technology Recapitulates Phylogeny: Artificial Life Art." *Leonardo* 31, no. 5 (1998): 371-376.

Roads, Curtis. "An Interview with Harold Cohen." *Computer Music Journal* 3, no. 4 (1979): 50-57.

Rokeby, David. "The Construction of Experience: Interface as Content." In *Digital Illusion: Entertaining the Future with High Technology*, edited by Clark Dodsworth. New York: ACM Press, 1998.

Romero, Juan and Penousal Machado. *The art of artificial evolution, a handbook on evolutionary art and music*. Berlin: Springer, 2008.

Rosenboom, David. "...the future of art and power. FOR THE LAST SEVERAL MILLION YEARS..." *THE COMPOSER magazine* 1, no. 14 (1970).

Rush, Michael. *New Media in Late 20th Century Art*. London: Thames and Hudson, 1999.

Scha, Remko. "Readymades, Artificial Art, New Media." *Exploding Aesthetics, Lier en Book, Series of Philosophy of Art and Art Theory, Vol.16*. Amsterdam: Annette W. Balkema and Henk Slager (eds.), 2001.

Schlachetzki, Sarah M. *Fusing Lab and Gallery: Device Art in Japan and International Nano Art*. Bielefeld: Transcript Verlag, 2012.

Schmidt, Rafael. *m.any: application of generative and cellular structures in architecture*. Zurich: ETH, 2005.

Schmied, Wieland. "Formen und Funktionen der Zeichnung in den sechziger und siebziger Jahren." In *documenta 6: 3.* Kassel: Dierichs, 1977.

Schwarz, Hans-Peter. *Media-art-history: Media Museum, Zkm, Center for Art and Media Karlsruhe*. Munich: Prestel, 1997.

Schwilgué, Charles. *Description abrégée de l'horloge de la cathédrale de Strasbourg.* Strasbourg: Imprimerie de Ph.-Alb. Dannbach, 1847.

Science + fiction, zwischen Nanowelt und globaler Kultur. Künstler und Wissenschaftler über Fremdes und Eigenes, Hirnforschung, Nanotechnologie, Wissenschaft und Öffentlichkeit. Zentrum für Kunst und Medientechnologie Karlsruhe 12.4. - 17.8. 2003. Berlin: Jovis-Verl., 2003.

Scott, Felicity D. *Architecture or techno-utopia: politics after modernism.* Cambridge, Massachusetts: The MIT Press, 2007.

Seaman, Bill and Otto Rossler. "Neosentience – a new branch of scientific and poetic inquiry related to artificial intelligence." *Technoetic Arts: A Journal of Speculative Research* 6, no. 1 (2008): 31-40.

Searl, John. "Minds, Brains and Programs." *Behavioral and Brain Sciences,* no.3 (1980): 417-457.

Sengers, Phoebe "Schizophrenia and Narrative in Artificial Agents." *Leonardo* 35, no. 4 (2002): 427-431.

Serexhe, Bernhard and Peter Weibel. *Wolfgang von Kempelen. Man-[in the]-Machine (ZKM Medienmuseum Karlsruhe 23.6 - 02.09.2007)*. Berlin: ZKM Publikationen, Matthes & Seitz, 2007.

Shanken, Edward A. "Hot to bot: Pygmalion's lust, the Maharal's fear, and the cyborg future of art." *Technoetic Arts: A Journal of Speculative Research* 3, no.1 (2005): 43-55.

Shanken, Edward A. "Contemporary Art and New Media: Toward a Hybrid Discourse?" Accessed October 11, 2013. https://hybridge.files.wordpress.com/2011/02/hybrid-discourses-overview-4.pdf.

Shanken, Edward A. "Cybernetics and Art: Cultural Convergence in the 1960s." In *From Energy to Information: Representation in Science and Technology, Art, and Literature*, edited by Bruce Clarke and Linda Dalrymple Henderson, 255-277. Stanford, Calif: Stanford University Press, 2003.

Shanken, Edward A. "Historicizing Art and Technology: Forging a Method and Firing a Canon." In *MediaArtHistories, edited by Oliver Grau, 43-70.* Cambridge, Mass.: MIT Press, 2007.

Shanken, Edward A. *Art and Electronic Media*. London: Phaidon Press, 2009.

Shapiro, Stuart C. and David Eckroth. *Encyclopedia of Artificial Intelligence.* New York: Wiley, 1987.

Shusterman, Richard. "Aesthetic Experience and Cyborg Interpretation." In *Exploding Aesthetics, Lier en Book, Series of Philosophy of Art and Art Theory, Vol.16*, edited by Anette W. Balkema and Henk Slager, 27-32. Amsterdam: Rodopi, 2001.

Simons, Geoff. *Are Computers Alive? Evolution and New Life Forms*. Brighton: Harvester, 1983.

Sims, Karl. "Evolving Virtual Creatures." In *SIGGRAPH 1994 Conference Proceedings*, 15-22. Addison-Wesley Pub, 1994.

Smith, Brian R. "Beyond Computer Art." *Leonardo* Supplemental Issue (1989): 39-41.

Smith, Brian R. *Soft Computing: Art and Design*. Massachusetts: Addison-Wesley, 1984.

Snow, C. P. *The Two Cultures*. New York: Cambridge University Press, 1998.

Soddu, Celestino "Introduction to Generative Art ‘98." Generative Art proceedings of the 1998 Milan First International Conference Generative Art '98 Milan: Librerie Dedalo, 1998.

Sommerer, Christa and Laurent Mignonneau. "Art as a Living System: Interactive Computer Artworks." *Leonardo* 32, no. 3 (1999): 165-173.

Sommerer, Christa and Laurent Mignonneau. "Genetic Manipulator." In *Memesis: The Future of Evolution*, edited by Gerfried Stocker and Christine Schöpf. Wien: Springer, 1996.

Sommerer, Christa and Laurent Mignonneau. "Modeling the Emergence of Complexity: Complex Systems, the Origin of Life and Interactive On-Line Art." *Leonardo* 35, no.2 (2002): 161-169.

Sommerer, Christa and Laurent Mignonneau. *Art @ Science*. Wien: Springer-Verlag, 1998.

Stocker, Gerfried and Christine Schöpf. *Takeover: Who's Doing the Art of Tomorrow = Wer Macht Die Kunst Von Morgen*. Wien: Springer, 2001.

Stuart Mill, John. *Collected works of John Stuart Mill*. Toronto and Buffalo: University of Toronto Press, 1963-1991.

Stuart, Susan A.J. and Chris Dobbyn. "A Kantian Prescription for Artificial Conscious Experience" *Leonardo* 35, no. 4 (2002): 407-411.

Taylor, Grant D. *When the Machine Made Art: The Troubled History of Computer Art*. New York: Bloomsbury Academic, 2014.

Tenhaaf, Nell. "Art Embodies A-Life: The VIDA Competition." *Leonardo* 41, no. 1 (2008): 6-15.

Thacker, Eugene. *The global genome: biotechnology, politics, and culture*. Cambridge, Mass.: MIT Press, 2005.

The Oxford Companion to Philosophy, edited by Ted Honderich. Oxford, New York: Oxford University Press, 2005.

Thomas, David. "Harold Cohen Expanding the Field: The Artist as Artificial or Alien Intelligence?" *Parachute: (Extra-Human AI), no.* 119 (2005): 47-67.

Thompson, David. "5 Young British Artists." In *Bernard Cohen, Harold Cohen, Robyn Denny, Richard Smith, Anthony Caro: Xxxiii Venice Biennale 1966 British Pavilion*. London: British Council, 1966.

Thompson, Michael. "Intelligent Computers and Visual Artists." *Leonardo* 7, no. 1 (1974): 227-234.

Tijus, Charles Albert. "Cognitive Processes in Artistic Creation: Toward the Realization of a creative Machine." *Leonardo* 21, no. 2 (1988): 167-172.

Tosa, Naoko. "Expression of emotion, unconsciousness with art and technology." In *Affective Minds: A Collection of Papers Based on Presentations at the 13th Toyota Conference, Shizuoka, Japan, 29 November to 2 December 1999*, edited by Hatano Giyoo, Naoyuki Okada and Hirotaka Tanabe, 183-202. Amsterdam: Elsevier, 2000.

Transmediale 2k+12 Festival Catalogue - Day Planner. Berlin: Kulturprojekte Berlin GmbH, 2012.

Turing, Alan M. "Computing Machinery and Intelligence." *Mind: a Quarterly Review of Psychology and Philosophy* 59 (1950): 433-460.

Turner, Jane. *The dictionary of art*. New York: Grove, 1996.

Tzara, Tristan. "dada manifesto on feeble love and bitter love." *391*, December 12, (1920): 47-49.

Ursprung, Philip. "Performative Kunstgeschichte." In *Kunstgeschichte und Gegenwartskunst: vom Nutzen und Nachteil der Zeitgenossenschaft*, edited by Verena Krieger. Köln: Böhlau, 2008.

Van Gulick, Robert. "Reduction, emergence and other recent options on the mind-body problem: a philosophic overview." *Journal of Consciousness Studies* 8, no. 9-10 (2001): 1-34.

Virilio Paul and Sylvère Lotringer. *Pure War: Twenty-five Years Later.* Los Angeles, Calif: Semiotext(e, 2008.

Wagnermaier, Silvia, and Siegfried Zielinski. *Variantology 1: On Deep Time Relations of Arts, Sciences and Technologies*. Köln: Walther König, 2005.

Walter, Grey. *The Living Brain*. New York: W. Norton & Company, 1953.

Watz, Marius. "Generative Art and Generator.X – A Talk with Marius Watz." *Digital Tools,* September 20, 2005. Accessed February 21, 2012. http://www.digital-tools-blog.com/interview/12-generative-art-and-generatorx-a-talk-with-marius-watz.

Weber, Jutta. *Umkämpfte Bedeutungen: Naturkonzepte im Zeitalter der Technoscience*. Frankfurt/Main: Campus-Verl., 2003.

Weibel, Peter. "It Is Forbidden Not to Touch: Some Remarks on the (Forgotten Parts of the) History of Interactivity and Virtuality." In *MediaArtHistories*, edited by Oliver Grau, 21-41. Cambridge, Mass.: MIT Press, 2007.

Weibel, Peter. "The Unreasonable Effectiveness of the Methodological Convergence of Art and Science." In *Art @ Science*, edited by Christa Sommerer and Laurent Mignonneau. Wien: Springer-Verlag, 1998.

Weizenbaum, Joseph. *Computer Power and Human Reason: From Judgment to Calculation*. San Francisco: W.H. Freeman, 1976.

Whitelaw, Mitchell. *Metacreation: Art and Artificial Life*. Cambridge, Mass: MIT, 2006.

Wiener, Norbert. *Cybernetics: Or Control and Communication in the Animal and the Machine*. Cambridge: The MIT Press, 1948.

Wiener, Norbert. *The Human Use of Human Beings: Cybernetics and Society*. New York: Avon Books, 1967.

Wilson, Stephen. "Artificial Intelligence Research as Art." In *Stanford Humanities Review 4.2, Constructions of the Mind: Artificial Intelligence and the Humanities*. Stanford, Calif: Stanford Humanities Review, 1995. Accessed October 21, 2009: http://web.stanford.edu/group/SHR/4-2/text/wilson.html.

Wilson, Stephen. "Computer Art: Artificial Intelligence and the Arts." *Leonardo* 16, no.1 (1983): 15-20.

Wilson, Stephen. *Art + Science Now.* London: Thames & Hudson, 2010.

Wilson, Stephen. *Information Arts: Intersections of Art, Science, and Technology*. Cambridge, Mass: MIT Press, 2002.

Youngs, Amy M. "The Fine Art of Creating Life." *Leonardo* 33, no. 5 (2000): 377-380.

Zivanovic, Aleksandar. "SAM, The Senster and The Bandit: Early Cybernetic Sculptures by Edward Ihnatowicz." In *Proceedings of the Symposium on Robotics, Mechatronics and Animatronics in the Creative and Entertainment Industries and Arts*, 1-7. Hatfield, UK: The Society for the Study of Artificial Intelligence and the Simulation of Behaviour, 2005.

Zivanovic, Aleksandar. "The development of a cybernetic sculptor: Edward Ihnatowicz and the senster." In *Proceedings of the 5th Conference on Creativity & Cognition* edited by Ernest A. Edmonds and Linda Candy, 102-108. New York, NY: ACM, 2005.

Curriculum Vitae

Personal Details

Boris Magrini
Nationality: Swiss
Place of origin: Losone (TI)
Born the: 2 of April 1975
E-Mail: mail@borismagrini.com
Website: borismagrini.com

Boris Magrini, Swiss art historian and curator, focuses on contemporary artistic practices in the intersection of arts, technology, science and society. He was curator at Duplex in Geneva, I Sotterranei dell'Arte in Monte Carasso and assistant curator at Kunsthalle Fribourg and Kunsthalle Zurich. Curated shows include *Mutamenti* (Bellinzona, 2007), *Anathema* (Fri-Art, Fribourg, 2007-8), *Modifier* (Dienstgebäude, Zurich, 2010) and *Leise Rehe-Wilde Beeren* (Cabaret Voltaire, Zurich, 2011-12). He organises talk series: Reality Check at Kunsthalle Zürich (2014) and Hackteria Swiss Curriculum, Corner College with Hackteria (2014-15). He edits the Italian pages of Kunstbulletin (Switzerland) and he regularly publishes on contemporary and media art in magazines, books and exhibition catalogues. Some of his recent publications include: "Hackteria: An Example of Neomodern Activism" (Leonardo Electronic Almanac, Vol. 20 Issue 1, 2014) and "Beyond Mere Tools", in Political Interventions, Edition Digital Culture 1, (Christoph Merian Verlag and Migros-Kulturprozent, 2014).

Professional Career

2012 - today	Editor Kunstbulletin, Schweizer Kunstverein, Neufrankengasse 4, 8026 Zurich.
2013 (apr-dec)	Assistant Curator Kunsthalle Zürich, Limmatstrasse 270, 8005 Zurich.
2005 - 2009	Director and Curator I Sotterranei dell'Arte, Antico Monastero delle Agostiniane, 6513 Monte Carasso.
2006 - 2007	Project Manager and Artistic Director Mutamenti, 6500 Bellinzona.
2004 - 2008	Assistant to the Direction Fri Art, Kunsthalle Fribourg, 1700 Fribourg.
2002 - 2004	Curator Duplex, Espace d'Arts Contemporains, 1201 Geneva.
2001 - 2004	Art History Teacher Ecole Bellecour Supdemod, 1201 Geneva.
2002 - 2003	Gallery Assistant Galerie Art & Public, 1205 Geneva.
2001 (jan-jun)	Internship MAMCO, Musée d'art moderne et contemporain, 1205 Geneva.

Education

2010 - 2015	Universität Zürich, 8001 Zurich PhD student, Philosophische Fakultät. Associated to Pro*Doc, Art & Science.
1995 - 2000	Université de Genève, 1205 Geneva A, Art History; B, Philiosophy; C, Italian Literature. Certificate: Master of Arts.
1990 - 1995	Liceo Cantonale, 6600 Locarno Certificate: Matura.

Foundations, associations and commissions

2014 - today	DECS**,** Repubblica e Cantone Ticino Member of the Fine Arts Committee.
2012 - today	Pro Helvetia, Zurich Independent expert, Visual Arts.
2010 - 2012	Pro Helvetia, Zurich Member of the Board of Trustees. Working Group Visual Arts and Cinema. Coordination Group of the Board of Trustees.
2010 - 2015	Association "La Rada", Locarno Board of directors.

Publications

"Alan Bogana - La seduzione oscura delle scienze esatte",
Kunstbulletin (2015), n.9, 70-71.

"Poolloop - Un festival per la cultura maker", *Kunstbulletin* (2015), n.7-8, 70-71.

"Short Cuts - Un secondo sguardo sull'arte cinetica e programmata",
Kunstbulletin (2015), n.6, 76-77.

"Céline Condorelli - Costruzione e narrazione", *Kunstbulletin* (2015), n.3, 52-53.

"Voglio vedere le mie montagne - Territorio e sacrilegio",
Kunstbulletin (2015), n.1-2, 64-65.

"Eva e Franco Mattes - The Darknet", *Kunstbulletin* (2014), n.12, 66-67.

"The Chase - Antropologia del recupero", *Kunstbulletin* (2014), n.9, 56-57.

"Lugano Arte e Cultura - Un'estate e un centro Arte e Cultura in Ticino",
Kunstbulletin (2014), n.7-8, 64-65.

"Beyond Mere Tools", *Political Interventions, Edition Digital Culture 1*, (Christoph Merian Verlag and Migros-Kulturprozent, 2014), 27-38/141-151.

"Festival Videoex - Un secolo di sperimentazione italiana",
Kunstbulletin (2014), n.5, 52-53.

"Se soigner avec des plaies", *Le Phare, Journal du Centre culturel suisse de Paris* (2014), n.165, 10-11.

"Marco Scorti e Jonas Hermenjat - Close to the Edge", *Kunstbulletin* (2014), n.4, 62-63.

"Paolo Cirio - Expect him", *Kunstbulletin* (2014), n.3, 50-51.

"Hackteria: An Example of Neomodern Activism", in *Red Art: New Utopias in Data Capitalism*, Leonardo Electronic Almanac (2014), Vol. 20, Issue 1, 58-71.

"Marie Velardi - Il tempo liquido", *Kunstbulletin* (2013), n.12, 52-53.

"Gianni Motti - Aforismi, eclissi e superpotenze", *Kunstbulletin* (2013), n.10.

"Biennale di Venezia - Incontro con il curatore Giovanni Carmine", *Kunstbulletin* (2013), n.6, 78-79.

"Mirko Baselgia - Una primavera di uranio", *Kunstbulletin* (2013), n.5, 52-53.

"Transmediale 2013 - Sex, octopus and social networks", *Kunstbulletin* (2013), n.1-2, 52-53.

"Should generative art be political?", in *Proceeding of the GA2012 – XV Generative Art Conference*, (Lucca, 2012).

"Vincent Kohler - più vero di un ready-made", *Kunstbulletin* (2012), n.12, 58-59.

"Luciano Rigolini - 131 surrogati", *Kunstbulletin* (2012), n.11, 56-57.

"Christoph Wachter & Mathias Jud - la rivoluzione senza Internet", *Kunstbulletin* (2012), n.9, pp.56-57.

"Anne-Julie Raccoursier - Nuages de fumée", " Les racines du patriotisme", in *Images en mouvement* (Zurich: Credit Suisse AG, 2012).

"Shift Festival – Eine Stimme für die Neuen Medien", *Kunstbulletin* (2011), n.11, 38-41.

"La nuova scena - 15 artisti sotto i 40 anni", *Kunstbulletin* (2010), n.4, 42-43.

"Aurelio Kopainig - Oltre ogni immaginazione", in *I Sotterranei dell'Arte 2009* (Monte Carasso: gce, 2009), 6-12.

"Prisca Groh", "Christian Moccia", "Miki Tallone", in *I Sotterranei dell'Arte 2008* (Monte Carasso: gce, 2009), 7-12.

"Marco Poloni - L'insostenibile probabilità degli eventi", *Kunstbulletin* (2008), n.7-8, 52-53.

"Stella Capes", in *Day after Day - Kunsthalle Fribourg, Fri-Art, 2006-2007* (Fribourg: Kunsthalle, Fri-Art, 2007), 278-279.

"Nicolas Pages", in *Day after Day - Kunsthalle Fribourg, Fri-Art, 2006-2007* (Fribourg: Kunsthalle, Fri-Art, 2007), 332-333.

"Lauris Paulus", in *Day after Day - Kunsthalle Fribourg, Fri-Art, 2006-2007* (Fribourg: Kunsthalle, Fri-Art, 2007), 310-311.

"Frédéric Post", in *Day after Day - Kunsthalle Fribourg, Fri-Art, 2006-2007* (Fribourg: Kunsthalle, Fri-Art, 2007), 308-309.

"St-Denis®", in *Day after Day - Kunsthalle Fribourg, Fri-Art, 2006-2007* (Fribourg: Kunsthalle, Fri-Art, 2007), 294-295.

"Poetica degli spazi bianchi", in *I Sotterranei dell'Arte 2006* (Monte Carasso: gce, 2007), 13-23.

"Véronique Zussau : le sublime détourné", in *Prismes et compressions - Véronique Zussau* (Stämpfli Verlag AG, 2007), 47-49.

Davide Cascio - Collection Cahiers d'Artistes 2006, (Luzern: Edizioni Periferia, 2006).

"Ana Roldan", in *Swiss Art Awards 2006*, (Bern: Bundesamt für Kultur, 2006), p.152.

Christian Kathriner, Davide Cascio – Scala per una città volante (Lugano: Gruppo Editori, Casa Editrice Indipendente, 2006).

"Miti, supereroi e disincanto", in *I Sotterranei dell'Arte 2005* (Monte Carasso: gce, 2006), 25-29.

"Gian Paolo Minelli - I ragazzi di Piedra Buena", *Kunstbulletin* (2005), n.12, 43.

"Donatella Spaziani", in *Beyond the Copan - Supernatural Urbanism* (Paris: ENSBA, 2005).

"Zen for movie - il video nelle sale del Festival internazionale del film di Locarno", *Kunstbulletin* (2004), n.10, 40-41.

"Archives et montage, poétique de la résistance. Artavazd Pelechian, Harun Farocki", *Kunstbulletin* (2004), n.1/2, 38-39.

Conferences and public talks

"Being immortal, again."
During the exhibition *Spooky Action at a Distance. Artes Mechanicae & Witch's Cradle*, Corner College, Zurich. 21 May 2015.

"Cranky Bytes"
During the exhibition *Quantum of Disorder*, Museum Haus Konstruktiv, Zurich. 11 February 2015.

"Bio-art and its multiples"
Biologische Kunst – Wissenschaft, Natur und Biohacking, Museum zu Allerheiligen, Schaffhausen. 13 June 2014.

"Hacking strategies in media art"
Whitewashing piracy / Normalcy, Royal Institute of Art, Stockholm. 16 April 2014.

"Should generative art be political?"
XV Generative Art Conference, Lucca. 11 - 13 December 2012.

"New media art and activism: an entangled relation"
Konflikt, Streit, Dissens: Störfall Kunst, Schweizerisches Institut für Kunstwissenschaft (SIK-ISEA), Zurich. 8 - 9 November 2012.

"Emerging behaviours. How a scientific debate about artificial intelligence, robotics and artificial life translates in the field of visual arts"
Compare – Translate – Connect, Université de Fribourg. 9 - 10 December 2010.